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THE

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BOMBAY NATURAL HISTORY SOCIETY

EDITED BY
SÁLIM ALI, S. B. SETHNA, Ph.D., and H. SANTAPAU, S.J.

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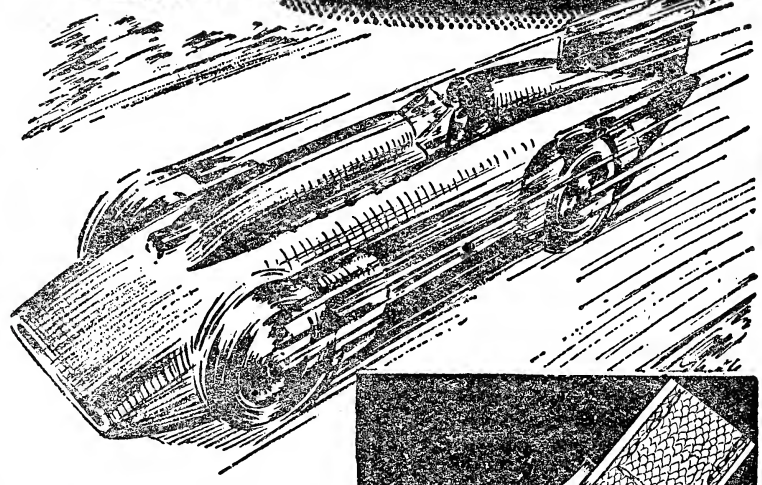

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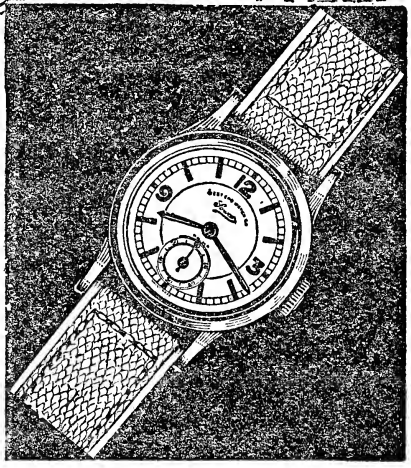

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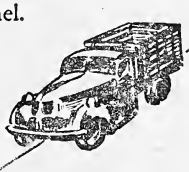

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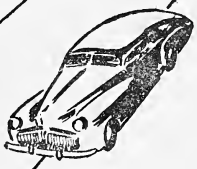

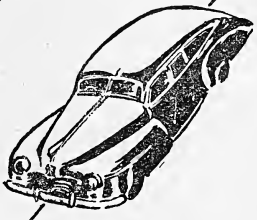

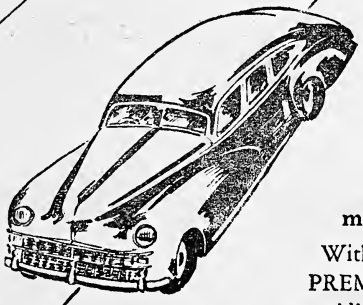

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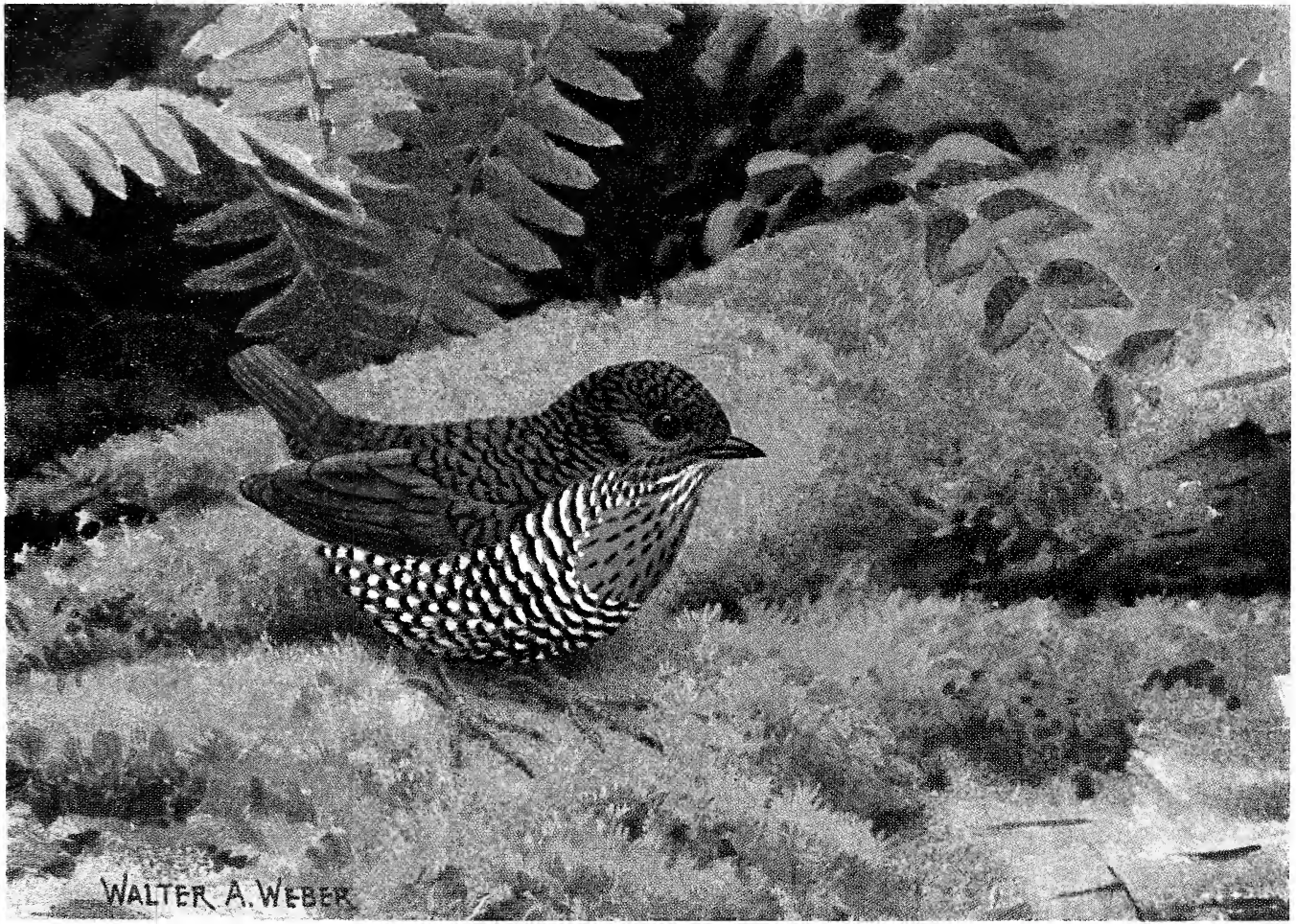


A NEW WREN FROM THE MISHMI HILLS, Assam.

Spelaeornis badeigularis Ripley

JOURNAL

OF THE

Bombay Natural History Society

1948 VOL. 48 No. 1

THE BIRDS OF THE MISHMI HILLS

BY

SÁLIM ALI AND S. DILLON RIPLEY

(*With a map, 1 coloured and 4 black and white plates*)

The Mishmi Hills form the extreme northeast border of Assam. Bounded on the south by the Lohit River and on the west by the Dihang as the upper Brahmaputra here is called, these hills rise from the alluvial plains about Sadiya at an altitude of not more than 500 ft. to heights of over 20,000 ft. on the Sikang or S.E. Tibet border. To the east over far lesser heights lies extreme northern Burma and the Irrawady watershed.

FAUNISTIC EXPLORATION.

Relatively little faunistic work has been performed in the Mishmi Hills. The first collecting in the plains and foothills about Sadiya and along the Lohit River towards Brahmakund which lies a few miles to the east of Tezu, was done by Mr. M. T. Ogle, a member of the Topographical Survey of India. Specimens collected by him were written up by Lt.-Col. H. H. Godwin-Austen in various numbers of the *Journal of the Asiatic Society of Bengal*, culminating in a combined list published in 1878. From these collections Godwin-Austen described the following from the Sadiya area:

Suthora ruficeps atrosuperciliaris
Turdinus williamsoni (=*T.b.striatus*)
Pellorneum ruficeps pectorale
Pomatorhinus stenorhynchus
* *Stachyris oglei*
* *Abroscopus flavogularis* (probably unidentifiable, see Ticehurst, *Ibis*, 1941, p. 178)
* *Staphidea plumbeiceps* (=*Siva castaneiceps rufigenis*)

* Species not collected by us.

Other forms described from the Mishmi Hills are:

Pellorneum ignotum Hume.

Alcippe collaris Walden (collected by Surgeon-Major F. Day at Sadiya, December 12, 1874) which has been placed in synonymy under *A.r.rufogularis.*

Lophophorus sclateri Jerdon.

Stuart Baker published a paper entitled 'On a small collection of Birds from the Mishmi Hills, N.E. Frontier of India' (*Rec. Ind. Mus.*, ix, pt. v, No. 17. 1913, pp. 251-4), based on some specimens collected by Capt. R. S. Kennedy, I.M.S. No forms are described as new, but the following were not secured by us:

Garrulus bispecularis.
Nucifraga hemispila.
Yuhina g. gularis.
Oreocincla mollissima.
Falco t. alaudarius.
Ithaginis cruentus kuseri.
Arborophila torqueola.

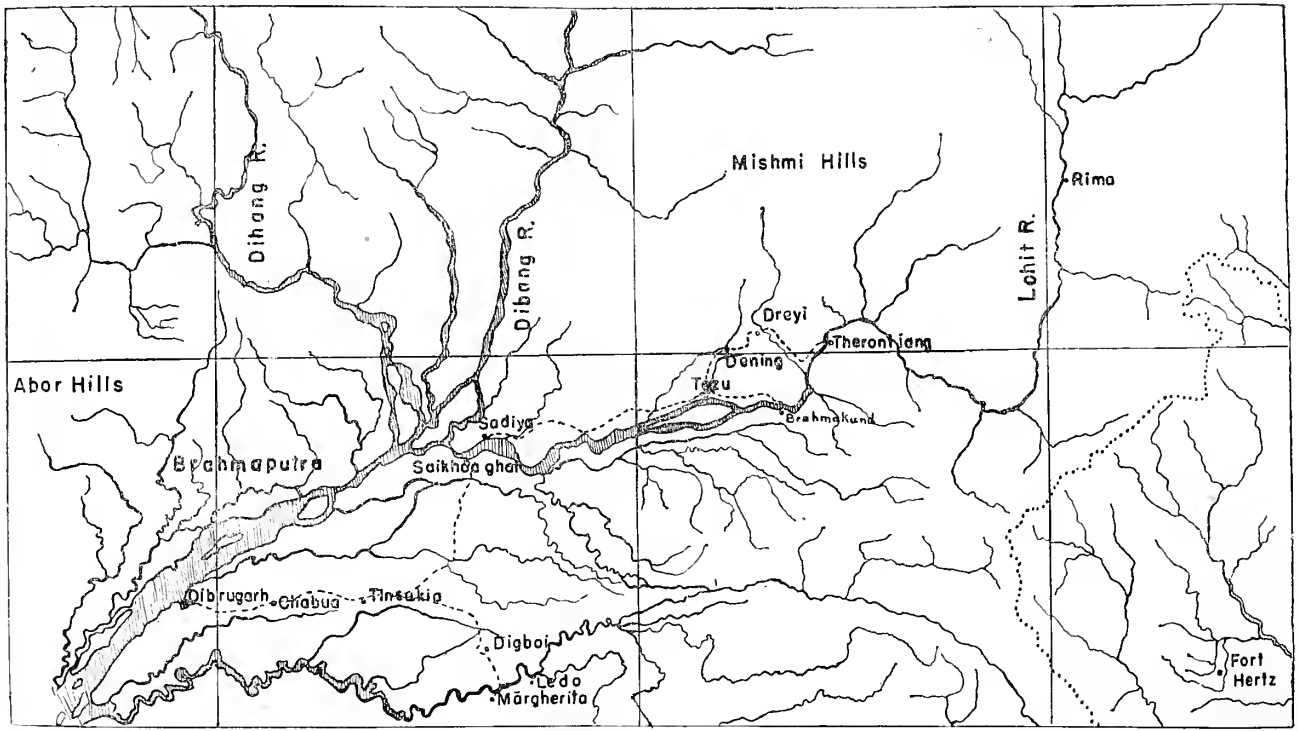
Lt.-Col. F. M. Bailey has collected a considerable amount of material in the Mishmi Hills, but his specimens which are in the British Museum have never been written up as a whole. Most of these birds consist, however, of high altitude species taken over the border in Chinese Tibet. Notations on his travels and lists of the specimens have appeared occasionally in the *Journal of the Bombay Natural History Society* (notably, Vol. xxii, 1913, pp. 366-369). Among these specimens, one, *Ixulus flavicollis baileyi*, collected at 7,000 ft., has been described by Stuart Baker (*Bull. B.O.C.*, xxxv, 1914, p. 17).

Herbert Stevens published a faunistic paper in the *Journal of the Bombay Natural History Society* xxiii, Nos. 2, 3 and 4, 1914-1915, pp. 234-268, 547-570, 721-736 (with map and plates) entitled 'On the Birds of Upper Assam' in which he deals with the Balipara area for the most part with occasional references to observations and collections made near Dibrugarh and Margherita. He apparently never actually collected across the Lohit River.

Geological Position.

The Mishmi Hills lie at about the end of the main west-east Himalayan geosyncline and to the east again the main tectonic strike undergoes a sharp bend towards the south into the Patkoi and Arakan Yomas. Recently de Terra (*The Geographical Review*, xxiv, 1934, etc.), Hora (*Current Science*, vi, 1938) and others have discussed the pre-glacial topography of the great rivers of the Himalayas. Present studies, from the physiographic point of view suggest that the former drainage of the upper Brahmaputra, the Tsang Po, may have been part of an early drainage to the east (Recent uplift and Post-Pleistocene) through the meridional valleys of eastern Tibet and Szechuan. An earlier suggestion (Pascoe, *Quart. Journ. Geol. Soc.*, 75, 1919), has been that the Tsang Po formerly drained westward into the headwaters of the Indus parallel to the Tertiary 'Indobrahm'. In any case, Hora's and others' work on the fish faunas of the Himalayan chain have certainly

Fort
Hertz



Map of the Mishmi Hills area. The Burma border is indicated by a dotted line to the east. The Dihang (the upper Brahmaputra), and the Dibang rivers are both geologically recent northward capturings of the Tibetean drainage system by the Brahmaputra.

demonstrated the separation of the two faunas as between the north and south faces of the mountains. This important fact is substantiated, at least in this case, by the relationships of the avian fauna. The sedentary, lower-altitude birds of the Mishmi Hills, separated by the gorges of the Brahmaputra from the Himalayas to the west, and with relatively easy access to the upper Irrawady drainage to the east, show a striking degree of relationship to the birds of the more western Himalayas of Sikkim and Bhutan. The present gorges of the Brahmaputra, while they could easily prove a barrier of great magnitude to some of the ground-loving skulking passerine birds, have in fact only served to develop speciation trends in apparently formerly continuous populations. The Mishmi Hills in this sense represent a recent 'island' separated by a channel from formerly united land areas.

Speciation Trends

Analysing the present known avian fauna of the Mishmi Hills points up the conclusion of the preceding paragraph as follows:

(*a*) the Mishmi Hills contain three endemic species, one of which is shared with the Margherita area. Two of these species, *Spelaeornis badeigularis* and *Abroscopus flavogularis* are closely allied with western species found in Nepal, Sikkim or Bhutan. One, *Stachyris oglei* is related to *S. striolata* from Bhamo, Peninsular Burma and Siam to the east.

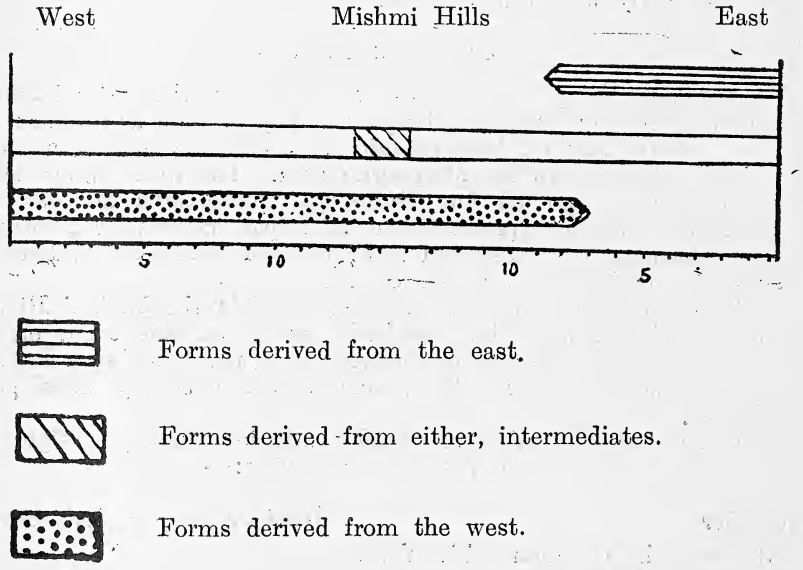
Of the twelve endemic subspecies found in the Mishmi Hills, five are shared with the Margherita area. Of this total, eight forms are closest to forms to the west along the Himalayan chain, two are strictly intermediate, and two are simply strikingly different.

Listed by order of their relationship with immediately contiguous geographic areas, one arrives at the following:—

Number	*West* or *Eastern* derivation			
3 forms in common with Yunnan & Ch. Tibet		E.		
4 forms in common with northern Burma		E.		
1 form in common with Cachar, N. Assam and Burma	W. primarily			
2 forms in common with Cachar & N. Assam	W.			
1 form in common with Chin Hills & N. Burma		E.		
5 forms in common with Sikkim	W.			
2 forms in common with Dafla & Miri Hills	W.			
6 forms in common with Margherita	4W.	1E.	1 Intermediate	
9 endemic Mishmi Hills forms	6W.		1 Intermediate	
			2 different	
33 Total	20	9	2	2

Eliminating the intermediate and different forms, 20 out of the corrected total of 29 forms or 68.9% show closest affinities to the avian fauna to the west. A second and minor point which is also important is that only three of these distinctive forms are closely identified with central Assam in the Cachar Hills of the Shillong plateau. This small percentage (15%) indicates what in fact from the physiographic evidence is true, namely that the more southerly channel of the Brahmaputra through central Assam with its feeders, the Dihing and the Lohit is old and has, therefore, formed an effective barrier to contacts from the north.

Combining species and subspecies endemic to the general area, the influences on the Mishmi fauna from the east and west may be expressed diagrammatically as follows:



Of the endemic forms which bear comparison with related subspecies or species to east or west, it is interesting to list the characters which separate them from their closest relatives. As might be expected where altitude factors remain constant, size plays virtually no part. However, in almost all forms critically examined, slight overlapping size differences tend to exist. In every case birds from the Mishmi Hills and immediately related areas such as north Burma tend to be somewhat larger than related populations from such areas in the west as Nepal or Sikkim. One form, *Æthopyga nipalensis koelzi* may be distinguished by larger bill size alone. Another, *Corvus macrorhynchus tibetosinensis*, is apparently represented in the Mishmi Hills by its southernmost population which shows a cline in wing and bill size.

The principal speciation trend is in color, and in fourteen out of seventeen cases the trend is towards darker, more heavily saturated, richer plumage. Melanins and phaeomelanins predominate. This is an overwhelming 79%. Of the remaining cases, two forms are

Photo Salim Ali

Dry river bed in forest, Tezu.

Photo S. D. Ripley

The Lohit river at Tezu.

Undergrowth of brackens and tree ferns on steep hill-side, Dening.

Photo by Salim Ali

The troublesome nettle—*Laportia crenulata.*

paler than their relatives to the west: *Pomatorhinus ochraceiceps stenorhynchus* and *Xiphirhynchus superciliaris intextus*. Both forms are paler and tend to be smaller than subspecies to the west, but are intermediate in these characters between the western forms and somewhat larger and darker forms to the east. This is an interesting reversal of the trend found even in congeners of one of the species, (*Pomatorhinus*), and might tend to indicate a parallel evolution of these two closely related species of neighbouring genera.

Itinerary

One of us (SA) arrived in Sadiya on November 20, 1946 and stayed in the Hills until January 2, 1947. The other arrived at Sadiya on December 23 and stayed until January 15. Our second group consisted of three other Americans, Mr. and Mrs. Sidney Legendre and Mr. Edward Migdalski. Sálim Alí stayed in Sadiya some weeks awaiting the rest of the party and then moved on to Tezu, a few miles farther up the Lohit at an altitude of 648′ above sea level. Tezu marks the cross roads. Farther to the east the dirt road continues to Brahmakund along the Lohit, or alternatively one may turn north at Tezu and proceed by motorable road to Dening in the foothills at 2290′. Here the road ends and a trail continues on up to Dreyi (5140′), the Tidding Ridge or Saddle (6000′), and on down to Theronliang, again on the Lohit, which marks the border of Administered Territory. Beyond this it is about 12 marches to the actual frontier of India itself. As our interest was the lower altitude fauna we concerned ourselves only with the Sadiya-Tezu-Dening-Dreyi area, where it is possible to sample three different altitudinal and life zones.

Ecological Zones

The area of the Mishmi Hills consisting of the lower slopes and adjacent alluvial plains covered by the present trip, falls under Champion's Group 1B (C2)—'Upper Assam Tropical Evergreen Forest'[1] (p. 46). The locality factors of this forest type are given as: Annual rainfall 90 to 150″ or more, well distributed with only 3 months (November to January) relatively dry; even then with heavy dews nightly. Monthly maximum temperature not exceeding 90°F., the mean minimum for January being close to 50°F., the absolute minimum being but little over 40°.

'From the point of view of temperature, the climate is thus definitely subtropical but the favourable moisture distribution and the complete absence of frost permits of the development of a forest indistinguishable from that of more southern latitudes. The soils are largely of recent alluvial formation over Tertiary sandstones and shales but the latter and crystalline rocks outcrop on the hills and carry a similar type of forest'.

The distribution of this forest type also includes the Abor, Dafla and Aka Hills of Assam north of the Brahmaputra.

---

[1] Champion, H. G., The Forest Types of India and Burma, *Indian Forest Records* (New Series)—Silviculture, Vol. I, No. 1—1936.

It is possible to characterize a number of typical zones where collecting was carried out:

(*a*) Lowland, alluvial zone. This area around Sadiya and Tezu is characterized by open country, either of an artificial nature, such as cut-over agricultural land or openings about houses, or tracts of endemic grass-covered land interspersed with scattered trees of *Bombax*, *Heterophragma* etc., and patches of shrub growth of fire hardy species such as *Zizyphus jujuba*, especially along the edges. This is the savannah stage of ecological succession to the climax (*b*) and (*c*) (tom. cit., p. 126). It is known here as 'chopras', 'cagri', 'ekra' etc. and is the characteristic habitat for such distinctive forms as *Pellorneum palustre*, *Pellorneum albiventre*, *Megaluris palustris* and *Timalia pileata*. *Saxicola torquata* also favours this biotope and *Prina polychroa* should be looked for in the area.

The artificially created areas play host to obviously recent invaders such as the commoner bulbuls, starlings and mynahs, king crows, dhyal thrushes and house sparrows. In addition raptores dependent either on man or on open areas, work gradually into such areas.

(*b*) Lowland jungle. About Tezu there are very large areas of original forest of the well-developed primary rainfall type. These forests probably reach their climax in the alluvial areas immediately adjacent to the foothills. This was one of the richest areas for birds principally small passerine forms, babblers, bulbuls and warblers. Here also were found Horsfield's Kaleege, junglefowl and hornbills, and in the nearby stagnant stream or lagoon areas occurs the White-winged Wood Duck. A tremendous concentration of rattans or canes made movement in this jungle extremely limited, and probably accounts for the scarcity of large carnivores.

(*c*) Mid-montane jungle. Dening is a splendid transitional area between the lowland and montane jungle types. It comprises of steep precipitous hill-sides under lofty dense evergreen jungle. Wild bananas and tree-ferns (up to 20 ft. high) are a feature of the landscape, while rattan brakes (*Calamus*) and bamboos predominate in patches. The enormous forest trees are heavily draped with lianas and creepers, and their trunks and branches covered with mosses. *Strobilanthes* abound on the opener hill-sides. Goat-weed (*Eupatorium*) which here seems to replace *Lantana* completely, overruns disused cultivation clearings in wild profusion, being intermixed with luxuriant bracken growth at the forest's edge. The spiny *Smilax* creeper loops and twines through the lower storey as if to mollify the enthusiasm of the too-eager collector, while that extremely vicious nettle *Laportia crenulata*, with harmless-looking clusters of white berries, holds a place in the undergrowth which cannot be ignored by anyone who has once had the misfortune to come in contact with it. A cleared area about the village and post of the Assam Rifles has brought in migrants and introduced species, but in the surrounding bamboo and rainfall facies there is a great concentration of low altitude Himalayan forms. Here were found *Pomatorhinus montanus*, a great variety of flycatchers, traces of the Peacock Pheasant, *Turdinus*, *Pnoepyga* and *Tesia olivea*.

Secondary shrub jungle on overgrown cultivation clearing, Dening.
(Dr. Ripley in centre).

Photos by Sálim Ali

Dense evergreen undergrowth, Tezu.

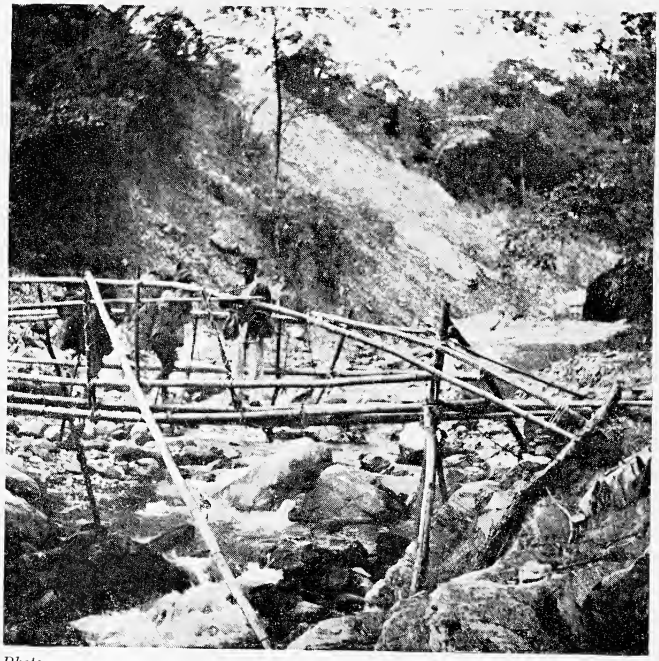


Photo Sâlim Ali

Makeshift bamboo bridge on the trail to Dreyi.

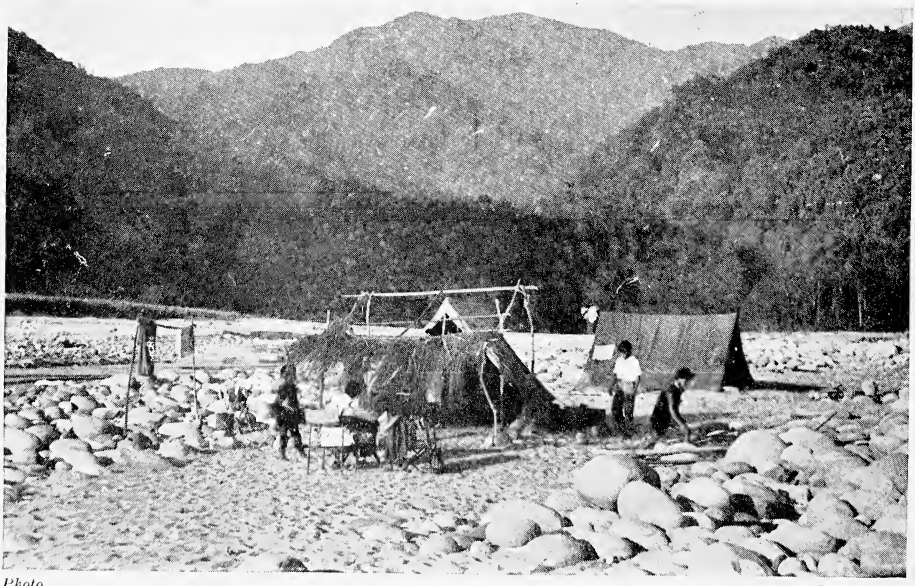


Photo S. D. Ripley

The expedition's camp in a river bed.

(*d*) Montane jungle. About 4000′ there seemed to be a significant change in the avian fauna beginning with such characteristic forms as *Megalaima virens* and *Arborophila*, and later showing us the characteristic higher altitude babblers such as *Tesia castaneocoronata*, *Siva strigula*, and *Alcippe cinerea*. In the neighbourhood of Dreyi, which has an annual rainfall of over 200″, the luxuriance of the forest reaches its climax. The almost vertical hill-sides are clothed with lofty trees and impenetrable shrub growth. Only torrential streams and waterfalls, which are abundant, break the continuity of the unending green. Wild banana trees of phenomenal height (18 to 25 ft.) and over-sized tree-ferns, with Fishtail palms and another species with leaves like the cocoanut are abundant and form a feature of the floristics. Dominant in the undergrowth, especially along the edge of forest trails, are species of *Polygonum* (?), *Saxifraga*, *Begonia* and *Rubus* all come into prominence above an elevation of about 3500 ft. Here also, at 5500′ *Sitta formosa* was found, and at 6000′ *Harpactes wardi*. The ridge at 6000′ is just in the beginning of the zone of heavy bamboos, but as no higher altitude was attained we did not collect the fauna of the oak-rhododendron facies, one to two thousand feet higher.

Bird Collecting in the Mishmis

Bird collecting in such terrain is fraught with difficulties and disappointments, and even frustration; it needs the devising and application of special techniques. The undergrowth is so dense and usually so full of lurking nettles, sprawling spiky *Calamus* 'whip-lashes' and spiny *Smilax* twiners, and the ground so thickly littered with a welter of criss-crossing rotten bamboo stems that penetration of the forest to any depth except along well-used game paths is often impossible. Any birds that present themselves here are usually at such close range that they get blown to smithereens when shot, and are useless as specimens. And it is seldom possible to increase the range sufficiently by backing into the tangled under bushes.

As a pendant to this difficulty other birds may be right up in the canopy of trees clinging on a vertical hill-side and towering 200 ft. or more above a forest trail. At this range, birds, even the size of green pigeons, look minute and are apt to escape unscathed through the pattern of shot. Smaller species do so in quite 9 cases out of 10. Even should a bird drop like a plummet it frequently gets partially buried in the thick bed of soft humus on the forest floor where, further obscured by the undergrowth, it defies search in an amazing way. The chances of recovery are further lessened when, as happens usually, the wounded bird glides away at an angle to fall, and then perhaps flutter along, in a conjectural spot hidden by forest a hundred feet or more down a 60 degree slope. Finding the proverbial needle in a haystack is easy work compared to retrieving such a wounded bird, and many interesting and tantalizing specimens are lost. On the whole, one is lucky if he can recover even 50% of the specimens he shoots. Occasions can be recalled, especially when unaccompanied by a local Mishmi, when 8 out of 10 birds eluded

recovery. One particularly unlucky morning stands out when every one of the 8 birds shot was lost!

Successful collecting in terrain of this nature has to be a combination of stalking and still-hunting. The hunter must try and induce the bird to come up to him rather than attempt to approach it. Birds seem to prefer the vicinity of rather opener glades and edges of trails to the gloomy forest interior. The art lies, therefore, in selecting a promising opening and keeping a careful lookout for any movement in the surrounding or overhanging jungle. With patience satisfactory results may be obtained in this way. The movement of a shy bird skulking in a thicket is often betrayed by no more than its shadow flitting across a gleam of sunlight. But this fleeting shadow may sometimes merely mean a falling leaf. Out of the corner of one's eye the gentle swaying of a fragment of bamboo-leaf caught in a spider's web, or even just a gossamer strand dancing lightly in the breeze with a shaft of sunlight playing on it, is apt to simulate the movement of a creeping bird and deceive the hunter momentarily.

Frequently a series of intriguing calls from within the forest tempts one to crash through in that direction, but one soon learns the futility of such procedure. The din of your progress usually sends the bird off long before you can reach within visual distance. When, stumbling and panting, you finally do manage to reach the spot it is, as often as not, only to discover that a mimicking Racket-tailed Drongo has been playing a practical joke on you!

Under conditions such as obtain in the Mishmis, netting birds seems to be a more satisfactory, and in many cases the only practicable proposition. Vertical running nets of the Italian and Japanese pattern were employed with considerable success by one of us (R). Stretched across openings in the shrubbery at spots likely to or observed to be used by birds crossing over from one part of the forest to another, and inspected and emptied of their captives morning and evening, these nets provided us with welcome specimens of a number of secretive species of whose very existence in the locality we should otherwise have been left in ignorance.

Acknowledgements

To the museums who were generous with the loan of specimens and of study space, we owe a considerable debt of gratitude. In particular the authorities of American Museum of Natural History have been most gracious and we especially wish to thank Dr. Ernst Mayr, Curator of the Whitney and Rothschild Collections. The Bombay Natural History Society loaned us the services of one of their field collectors, provided all available museum facilities and help in numerous other ways. In addition we must thank Mr. N. B. Kinnear, Director of the British Museum (Natural History) for his help and continual kindness. Dr. Herbert Friedmann of the U. S. National Museum has kindly assisted with the specimens in his care on frequent occasions. Yale University graciously sanctioned the leave of absence during the academic year for one of us, and Dr. Carl O. Dunbar, Director of the Peabody Museum, has been helpfulness itself at all times.

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LIST OF THE BIRDS

New forms listed below have been described by Ripley in the *Proceedings of the Biological Society of Washington.* [Vol. 61, 1948 (June 16), pp. 99-110].

PODICEPIDAE

Podiceps ruficollis: Little Grebe.

Noted at Dibrugarh, and probably found along the Lohit River.

PHALACROCORACIDAE

Phalacrocorax niger: Little Cormorant and

P. fuscicollis: Indian Shag were both seen at Dibrugarh and probably work up the Lohit.

ARDEIDAE

Egretta alba: Large White Egret and

E. intermedia: Lesser Egret were seen at Dibrugarh and up along the Lohit River as far as Tezu.

Egretta garzetta garzetta (Linnaeus): Little Egret.

Two males taken at Chabua and Tezu measure; wing 266, 272; culmen 84, 88. Soft parts; iris yellow; ocular skin pale bluish green; bill, upper mandible black, lower, whitish; legs black, feet yellowish green. The plumes and crest in these winter egrets are much reduced or lacking.

Bubulcus ibis coromandus (Boddaert): Cattle Egret.

Males and females were taken at Chabua and the form was seen at Dibrugarh. It undoubtedly occurs in the Lohit Valley.

Ardeola grayii: Pond Heron.

Seen throughout the area.

Butorides striatus: Little Green Bittern.

Seen at Tezu.

CICONIIDAE

Ciconia nigra Black Stork, **C. episcopa** White-necked Stork, **Leptoptilos dubius** Adjutant Stork and **L. javanicus** Lesser Adjutant Stork were noted in the low country between Sadiya and Dibrugarh.

ANATIDAE

Asarcornis scutulata : White-winged Wood Duck.

A pair were seen at Tezu and near Brahmakund in January. They haunt the jungle-grown streams and do not usually come out onto the broad gravel banks of the Lohit.

Casarca ferruginea : Ruddy Sheldrake.

The Brahminy duck was seen in pairs along the Lohit River.

Mergus merganser merganser Linnaeus : Goosander.

A pair were collected at Tezu January 10. They measure: wing ♂ 296, ♀ 259. Soft parts: ♂ iris black; bill; upper mandible, culmen black, sides scarlet, lower mandible black; legs reddish orange ♀ iris dark brown; bill, upper mandible brownish red, culmen black, lower mandible reddish orange; legs reddish orange, webs light brown.

Stuart Baker (F.B.I., Birds, vi, 1929, p. 471) notes that all specimens of merganser taken in the Himalayas appear to belong to the race *orientalis*, but these birds are typical *merganser*.

A flock of 40-50 of these mergansers was present on the Lohit.

HELIORNITHIDAE

Heliopais personata : Masked Finfoot.

This species was seen by one of us (SA) at Dibrugarh, and is noted by Godwin-Austen as having been seen near Sadiya by Ogle (l. c., 1878).

ACCIPITRIDAE

Pernis apivorus ruficollis Lesson: Indian Crested Honey Buzzard.

A female taken at Sadiya in November was very fat and had a wing measurement of 398.

Haliastur indus : Brahminy Kite.

Seen along the upper Brahmaputra.

Spizaëtus sp. : Hawk-Eagle.

A hawk-eagle was seen on the Tidding Saddle on January 5.

Ictinaëtus malayensis : Black Eagle.

This species was noted by R. on the Tidding Saddle on January 4.

Haliaeetus leucoryphus : Ring tailed Fishing Eagle.

Seen at Tezu.

Icthyophaga ichthyaëtus : Grey-headed fishing-eagle.

Noted by SA. at Dibrugarh and probably occurs up the Lohit.

Circus aeruginosus : Marsh of Harrier.

Seen by SA. at Sadiya.

Spilornis cheela : Crested Serpent-Eagle.

Noted at Tezu and Dening.

FALCONIDAE

Falco severus severus Horsfield : Burmese Hobby.

Three females were taken at Tezu. They measure: wing 221, 244, 245.5, tail 95, 111, 119, culmen 14, 15, 16. Soft parts : iris brown; cere and ocular area yellow; bill, upper mandible black, lower, greenish yellow basally, black distally; legs orange-yellow, nails black.

These birds were found in open scrub near the Lohit. One female was noted with another bird standing close together on a branch and flapping its wings either in a begging stance or possibly simulating copulation. The birds were noticed by their shrill squealing calls. The ovaries were undeveloped.

PHASIANIDAE

Arborophila rufogularis rufogularis (Blyth) : Rufous-throated Hill-Partridge.

A female collected on the trail between Denning and Dreyi on December 31 at 4000' measures: wing 142, tail 53, culmen 17.5. Soft parts: iris brown; ocular skin red; back of tarsus yellowish-white; tarsal scutes and feet pinkish red.

This species seems to like thick original forest between 4 and 6,000 feet and is most difficult to see. They have a mournful descending whistle, commonly uttered in the late afternoon. Occasionally this whistle is given at close intervals, gradually increasing in frequency, working up the scale until a sort of climax is reached. This seems to be a threatening or territorial call, for two birds will gradually work through the forest towards each other calling normally, and then when they are quite close, will give the climax call, apparently on the margins of their respective territories.

Lophophorus sclateri Jerdon : Sclater's Monal Pheasant.

Several fans were purchased from Mishmis. They were made from the tail feathers of this species. Normally the handles were of bamboo or musk deer fur, but one fan handle was made from the head, neck and breast of a cock Impeyan in addition to the upper tail coverts and tail used for the blade. The culmen of this specimen measures 34mm and the white tips on the central tail feathers in two cases measure 19.5 and 22.5mm. respectively. It is perhaps worth noting that these examples and a complete male collected in the same area (A.M.N.H. coll.) have rather clear and unstreaked white upper tail coverts whereas Yunnan birds appear to have more black streaks along the centers of these feathers. The plate by Wolf of the type specimen, however, shows heavy black streaking.

(In one of the fans are inserted several flank feathers of a Blood Pheasant.)

Gennaeus horsfieldii horsfieldii (G. R. Gray) : Black-breasted Kalij Pheasant.

This species is common in the lowland climax forest at Tezu. However, the wild canes are so thick in the substage that the forest is virtually impenetrable except where paths have been cut or elephant have recently been moving. I saw both males and females and was able to observe the characteristic adult male plumage of this form, but my only shot was a snap one with small shot which failed to reach the quarry (R).

Gallus gallus spadiceus Bonnaterre : Red Junglefowl.

A male was taken at Tezu on January 10, by a Mishmi hunter, the only bird of the trip secured by this means! The wing measurement is 236 mm. Soft parts : iris yellowish brown; bill, upper mandible brown, lower pale horn; legs dark slate; wattles pinkish red. This bird as might be supposed is somewhat intermediate and approaches *murghi* but the color of the small ear lappets, the general darker tone of the plumage, and the reduced dark central streaks on the golden-yellow neck hackles place it nearer the Burmese race.

Polyplectron bicalcaratum subsp. : Peacock-Pheasant.

This bird evidently occurs in the vicinity of Dening, but efforts to trap or collect it were unavailing. Several Mishmi fans were bought from the hill people. The tail and scapular feathers represented are of *bicalcaratum* but darker than any specimen of *bakeri* seen by me. Two specimens from Margherita and one from Tura in Assam in the A.M.N.H. coll. approach this colour, but are lighter. In addition there is a tendency to reduced spotting on these feathers. The spots themselves seem somewhat elongate. The margins around the 'eyes' on the tail feathers are also reduced. The outer tail feathers have only black shading around the eyes, lacking the buffy ring altogether.

CHARADRIIDAE

Lobivanellus indicus: Red-wattled Lapwing.

Hoplopterus indicus: Spur-winged Plover.

Charadrius dubius: Little Ring Plover

Seen at Sadiya and Tezu.

SCOLOPACIDAE

Tringa totanus: Redshank.

T. ochropus: Green Sandpiper.

Actitis hypoleucos: Common Sandpiper.

Erolia sp. Stint.

All seen along the Lohit or Upper Brahmaputra.

RECURVIROSTRIDAE

Ibidorhyncha struthersii Vigors: Ibis-bill.

Two females were shot on the Lohit River near Tezu on January 9. They measure: wing 240, 246. Soft parts are noted as: iris red; bill dull reddish brown; legs pinkish gray.

Stevens's description (*J.B.N.H.S.*, xxxiii, 1915, p. 727.) of the behaviour of these wintering Ibis-bills is quite as we saw them in January. They were fairly shy and were taken only when they decided to double back from up stream, flying high over the river, and apparently avoiding flying over the heavy forest.

GLAREOLIDAE

Glareola maldivarum: Large Pratincole or Swallow Plover.

Noted at Tezu; larger than *lactea*.

COLUMBIDAE

Sphenurus apicauda apicauda (Blyth): Pin-tailed Green Pigeon.

Three males and two females were collected at Dening and Tezu. They measure: wing ♂ 167-173, ♀ 165, 168; tail ♂ 170-184, ♀ 144, 161; culmen ♂ 20-23, ♀ 21,22. Soft parts: iris brownish red; ocular area blue; bill, basally blue, distal half of maxilla green; feet red.

In common with other green pigeons and the Falconidae has habit of sitting fluffed out on topmost bare twigs of towering trees on cold mornings to catch first rays of sun. Feeding commences later.

Sphenurus sphenurus sphenurus (Vigors): Wedge-tailed Green Pigeon.

A female was taken at Dreyi on January 1. It measures: wing 169, culmen 18. Soft parts: iris, inner ring blue-gray, outer ring reddish-orange; bill bluish-slate; feet pinkish red.

Messrs. Peters and Greenway have kindly compared this single specimen with the series of *yunnanensis* at Harvard and agree that it represents *sphenurus* although approaching the former subspecies in the darker green of the upper surface of the tail.

Treron pompadora phayrei (Blyth): Ashy-headed Green Pigeon.

Two males and a female were taken at Tezu. They measure: wing, ♂ 159, 163, ♀ 155; tail ♂ 85·5, 97, ♀ 81: culmen ♂ 20, 20·5, ♀ 18·5.

Soft parts: iris orange-brown; bill french gray; feet pinkish-red. In larger flocks and more alert than *S. apicauda*.

Ducula aënea sylvatica (Tickell): Indian Green Imperial Pigeon.

A male taken at Tezu has a wing measurement of 237 mm. Seen solo, or in twos and threes or small parties.

Ducula badia insignis Hodgson: Hodgson's Imperial Pigeon.

A pair were collected at Dening and Dreyi. They measure: wing ♂ 236.5, ♀ 253; culmen ♂ 26, ♀ 27. Soft parts: iris whitish; bill cerise, tip plumbeus-brown; feet dull cherry red.

These fresh skins are so different in tone to old specimens that it is difficult at first glance to assign them to the same race. The oxidation process inherent in foxing has turned old skins into brown and copper colored birds on the upper parts, taking away the grayish bloom of the fresh skin.

Birds from upper Assam (especially Margherita) have a tendency towards the gray head of Burmese *griseicapilla*.

The flight silhouette in the distance is crow-like — slow, deliberate wing beats.

There is a time in the late afternoon before the sun leaves the trees when these pigeons sit silently on the very tops of the largest trees, preferably on some dead or exposed branch. A moment or so after the sun has cast them into shadow they are off quickly and silently to their roosts.

Chalcophaps indica: Emerald Dove

Seen at Tezu.

Columba punicea Blyth: Purple Wood-Pigeon.

A female was obtained December 26 at Dening and another female December 15 at Tezu. They measure: wing 216.5, 221; culmen 17. Soft parts: iris yellowish-red, deep orange; cere, base of bill and eyerim magenta; tip old ivory, flesh; legs and feet pinkish-red; claws ivory.

Streptopelia orientalis agricola (Tickell): Rufous Turtle Dove.

A pair taken by S.A. at Sadiya have wing measurements of: ♂ 185, ♀ 197. In the ♂ the testes were enlarged to 20 × 8 mm. (2 December)!

Streptopelia chinensis edwardi Ripley: Assam Spotted Dove.

Ten specimens were taken at Chabua, Panitola, Sadiya and Tezu. They measure:

	Wing	Tail	Culmen
♂♂	146, 148	145, 146	17, 20
♀♀	141-150.5 (145.4)	139-145 (141.7)	16. 5-19 (17.5)

Soft parts: iris pinkish purple, dull brownish orange; orbital skin magenta; feet pinkish purple.

This race differs from *suratensis* by being conspicuously darker in tone of plumage on the back, rump, upper tail coverts and upper surface of the rectrices. The terminal bars on the feathers of the back and median wing coverts are darker buff in tone than in *suratensis* and much reduced in extent. There is a tendency towards larger size in this race although it is slight.

From *tigrina* of Burma this race differs by being darker on the upper parts, and by having more distinct dark margins to the back feathers. Stuart Baker (F.B.I., Birds, v. 1928, p. 243) remarks that Cachar and Manipur birds are intermediate between *suratensis* and *tigrina*. In the case of these North-east Assam birds, this is only true as far as the reduction in the terminal barring on the back is concerned. In addition these birds are darker than either of the other races.

Call noticeably different from *suratensis* of peninsular India. Ends abruptly with *krūk* in place of the prolonged *kroo*.

PSITTACIDAE

Psittacula alexandri: Red-breasted Parakeet.

P. cyanocephala: Blossom-headed Parakeet.

Noted at Sadiya and Tezu but not secured.

CUCULIDAE

Rhopodytes tristis tristis ≶ saliens: Large Green-billed Malkoha.

Two females were taken at Sadiya and Dening. They measure: wing 164, 167, tail 330, 372, culmen 34, 37. Soft parts: iris brown, red; ocular skin crimson magenta, red; bill green, horny-green, legs and feet bluish gray, greenish slate.

These birds have longer bill measurements than any specimens in the American Museum of Natural History coll. The wing measurement agrees with *tristis* but the tail measurement with *saliens*. The upper parts appear darker than typical *tristis*. The white tips on the four tail feathers of one specimen measure only 11 and 11.5 mm. along the shaft.

Centropus sinensis: Crow-Pheasant.

Noted at Tezu in December.

STRIGIDAE

Glaucidium brodiei brodiei (Burton): Western Collared Pigmy Owlet.

Two males and a female were collected at Dening and Dreyi. They measure: wing ♂ 86.5, 89, ♀ 93.5; tail ♂ 54,57, ♀ 61; culmen (from cere) ♂ 10.5, 12, ♀ 11.5. Soft parts: iris yellow; bill and feet yellowish-green.

One male at Dreyi was caught in a bird net, evidently attracted by a specimen of *Stachyris chrysaea* already caught. The other two birds were each seen in the day time as they were being mobbed, in one case by White-throated Bulbuls, again by sunbirds (*Aethopyga* sp.).

Glaucidium cuculoides austerum Ripley[1]: Mishmi Barred Owlet.

Seven specimens of this, the most common diurnal owlet, were collected from Sadiya up to Dening. These birds measure; wing ♂ 151.5-154, ♀ 156-160; tail ♂ 82-88, ♀ 87-90; culmen (from cere) ♂ 16.5-18.5, ♀ 16.5, 17. Soft parts: iris yellow; bill and legs yellowish-green; cere greenish-yellow.

In colour these birds are very rufous-brown. The range of this race is from Sikkim east through Bhutan and northern Assam in Lakhimpur and the Mishmi Hills to the upper Hukawng Valley of Burma.

Call: *Woioioioi . . . . . keeek.*

Athene brama ultra Ripley: North Assam Spotted Owlet.

This bird was seen at Sadiya but not actually collected north of Chabua. The race differs from *indica* by somewhat larger size and darker coloration.

Call: distinctly harsher and more high-pitched than in *A. b. brama* or *indica* of peninsular India.

HEMIPROCNIDAE

Hemiprocne coronata: Crested Tree-Swift.

Crested swifts, presumably of this species, were noted above the high forest trees at Tezu.

TROGONIDAE

Harpactes erythrocephalus erythrocephalus (Gould): Red-headed Trogon.

Specimens taken at Tezu and Dening measure: wing ♂ 157, 159, ♀ 149; tail ♂ 187, 192, ♀ 180; culmen ♂ 21, 22, ♀ 19. Soft parts were noted as: iris ♂ red, ♀ pale reddish brown; ocular area ♂ bluish purple, ♀ pale bluish purple; bill ♂ blue, purplish at base, ♀ blue, tip black; feet fleshy brown.

The vermiculation on the wings of these specimens is very fine and close.

Harpactes wardi Kinnear: Kingdon-Ward's Trogon.

Two females of this little known species were collected on the Tidding Saddle on January 3. They measure: wing 170.5, 175.5; tail 228, 219; culmen 19, 19.5. They do not seem to differ from typical *wardi* in color as represented in plate xxlv (Delacour and Jabouille, 'Les Oiseaux del' Indochine Francaise', ii, 1931, p. 264) except that the feathers about the eyes and lores are actually a rich black in tone. Female specimens from Burma and Indo-China are so faded that no colour comparison is possible.

Soft parts: iris reddish brown; ocular skin pale blue; bill basally pink, distally yellow with black culmen and two black patches on lower mandible; feet whitish, nails dark brown.

These birds were tame and unsuspicious when collected. One female appears to be a young bird in post-juvenal plumage which does not differ from the adult except in the comparatively narrower tail feathers.

ALCEDINIDAE

Ceryle lugubris guttulata Stejneger: Himalayan Pied Kingfisher.

A male and female were shot at Tezu and Dening. They measure: wing ♂ 189, ♀ 187; tail ♂ 114, ♀ 109; culmen ♂ 80, ♀ 71.

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[1] Described in *Zoologica*, 33, pt. iv, Dec. 31, 1948.

These birds are shy and difficult to observe. They have a peculiar rather jerky flight and give the impression of enormous size in the narrow valleys which they frequent. Soft parts ; iris brown ; bill basally gray, distally black with a horny tip ; feet grayish brown.

Birds from Sikkim, Nepal and the Himalayan Punjab are paler and slightly smaller than eastern Himalayan birds. The back and upper wing coverts are less blackish and the white spots on the feathers of these areas are larger, more like bars, less like spots. There seems to be a slight increase also in the amount of white on the outer feathers of the crest.

For these more western birds the name *continentalis* Hartert is available.

This Kingfisher also seems to keep to an accustomed route on a punctual daily schedule, at least when going to roost. The Tezu specimen was timed by SA on three consecutive evenings as it coursed up a thickly wooded forest stream soon after sunset. The bird was observed to pass under a certain wooden bridge (where not more than about 30 yards of the stream was visible) each day between 17.5 and 17.10 o'clock. On the fourth evening SA took up his position at the bridge betimes. He slipped the safety catch at 17.5 and shot the bird at exactly 7 minutes past five, just as it had crossed under !

Ceryle rudis : Pied Kingfisher.

This species was seen by SA. at Tezu along the same stretch of river as *guttulata.*

Alcedo atthis bengalensis Gmelin : Common Indian Kingfisher.

A male taken at Tezu has a wing measurement of 74.

Pelargopsis capensis : Stork-billed Kingfisher.

Noted at Tezu but not collected.

MEROPIDAE

Nyctyornis athertoni : Blue-beared Bee-eater.

This species was seen at Tezu and Dening.

BUCEROTIDAE

Aceros nipalensis : Rufous-necked Hornbill.

A single bird was seen on the Tidding Saddle. This species has an extraordinary habit of diving with closed wings for some distance to make long swooping dips in its flight, like a woodpecker. The noise of its outstreched pinions when it resumes normal flight is a loud 'whirr' which can be heard at a great distance.

Anthracoceros malabaricus malabaricus (Gmelin) : Large Indian Pied Hornbill.

A male taken at Tezu December 5, measures : wing 336, tail 318, bill (from gape) 159, tarsus 64. This is very large although it can be matched by other specimens from northern Bengal.

[**Berenicornis comatus** (Raffles) : Long-crested Hornbill.

Identity doubtful, but the colour scheme, size and other particulars recorded of a bird seen by SA at Tezu fit no other species.]

Buceros bicornis : Great Pied Hornbill.

A number of these birds flew over the road between Tezu and Dening in the late afternoon between four-thirty and five-thirty. In every case the flight seemed to be a routine one, performed at the same time each evening. Unfortunately I was unable to secure any specimens due to lack of carrying ammunition.

This keeping to a fixed route on a daily schedule was noted also in the case of 3 other pairs or parties. SA further notes that the rasping noise made by the steady cumbrous wing beats could be perfectly reproduced by scraping a fingertip on the canvas pork-pie hat while on his head !

CAPITONIDÆ

Megalaima virens mayri Ripley: Mishmi Great Barbet.

A male, the type of the race, taken on the Tidding Saddle above Dreyi measures: wing 147, tail 102, culmen 45. This race is as dark as *clamator* from North Burma, but has a yellow nape as in *magnifica*.

This species is wary and hard to observe. We noted it from about 3,500 ft. up to the crest of the Tidding Saddle at 6,000 ft. The ringing call, *kee-ow, kee-ow, kee-ow*, repeated over and over can be heard for over half a mile. Interspersed with this is a soft single *tock* which does not carry more than a few yards.

Normally one sees these birds perched very still on extremely high trees, usually on bare branches at the top. When they fly they leave their perch with a distinct spring or hop. They have a habit of closing their wings and swooping in great dips across a valley, like a woodpecker. Opened, the wings are held stiffly and produce a whirring sound like a hornbill in miniature.

On the Tidding Saddle in December/January these birds were gathered in large flocks and were feeding on various species of *Ficus* and flowering rhododendron. They were difficult to approach and although observed in numbers only one specimen was secured.

Megalaima zeylanica hodgsoni Bonaparte: Assam Green Barbet.

A male taken at Sadiya has a wing measurement of 135·5.

Megalaima asiatica asiatica (Latham): Blue-throated Barbet.

Eleven specimens of this barbet were collected at Sadiya, Tezu, Dening and Dreyi. A male and a female are moulting on December 29 and January 3. These birds have a wing measurement of: ♂ 103·5-111·5 (106·2), ♀ 104·5-108·5 (106·5). Soft parts are noted as: iris brown to red-brown (♂); bill, upper mandible basally greenish yellow, culmen and tip black, lower mandible greenish yellow, tip black; eyelids orange, legs grayish yellow.

In a series, these birds appear slightly duller and darker than thirteen birds from Bengal, U. P. and Nepal.

Call: *Kūtroo, Kūtroo* etc., almost indistinguishable from that of *M. zeylonicus*, but in a higher key.

Megalaima franklinii franklinii (Blyth): Golden-throated Barbet.

A pair taken at Dreyi, January 6, measure: wing ♂ 112, ♀ 98; tail ♂ 69, ♀ 62; culmen ♂ 25, ♀ 24. Soft parts: iris brown; bill black, grayish at base; legs greenish slate, pads dull yellow.

PICIDÆ

Picus canus gyldenstolpei Stuart Baker: Assam Black-naped Woodpecker.[1]

A single male was collected at Sadiya. It measures: wing 141, tail 101, culmen 37. Iris dark crimson.

Picus chlorolophus burmae Meinertzhagen: Burmese Small Yellow-Naped Woodpecker.

A male from Dreyi and a female from Dening measure: wing ♂ 132, ♀ 128; tail ♂ 95·5, ♀ 87; culmen ♂ 27·5, ♀ 27.

Burmae (*Bull. B.O.C.*, 44, 1924, p. 54.), seems a poorly characterized race in size, but birds from this area do have more of a suffusion of golden on the back, and orange on the nuchal feathers. Soft parts are noted as: iris red, bill, upper mandible black, basally yellowish green, lower mandible yellowish green; legs green.

Picus flavinucha flavinucha Gould: Large Yellow-naped Woodpecker.

A male taken by SA at Tezu measures: wing 177, tail 125, culmen 46. Soft parts: bill pale gray, slightly darker at base of lower mandible; orbital skin yellowish-green; legs and feet greenish-gray, claws plumbeous.

Gecinulus grantia grantia (McClelland) : Pale-headed Woodpecker.

Three specimens were taken at Dening and the species was also noted at Dreyi. They measure : wing ♂ 124.4, 126.5, ♀ 125. Soft parts : iris reddish brown, black ; bill bluish-ivory, bluish-white, whitish, basally bluish ; legs and feet olive ; claws horny brown, gray.

The two males are quite greenish on the underparts although in this they are matched by a male from Margherita in the A.M.N.H. coll. One of the males is quite blackish below, darker than any specimens examined, and the golden nuchal feathers are tinged with olive-green.

Noisy pairs in mixed bamboo forest. Utters nasal *Chaik-chaik-chaik-chaik-chaik-chaik* commencing loud and slow, increasing in tempo but becoming less loud and fading off towards end. Also makes a loud, harsh, quick-repeated *Cherēker-cherēker-cherēker* very reminiscent of the Black-throated Jay (*Garrulus lanceolatus*) of W. Himalayas.

Blythipicus pyrrhotis pyrrhotis (Hodgson) : Red-eared Bay Woodpecker.

A female taken at Tezu on January 13 was the only one secured. In colour this specimen appears slightly darker than topotypical material from Nepal. It measures : wing 150·5, tail 91, culmen 46·5. Soft parts : iris brown, bill yellow, greenish-yellow at base of lower mandible ; legs blackish brown.

This woodpecker was on a low stump only two feet off the ground when secured. It was making a loud harsh characteristic call, frequently repeated.

Micropternus brachyurus phaioceps Blyth : Northern Rufous Woodpecker.

A female from Dening measures : wing 124·5 ; tail 67 ; culmen 25. This race as distinguished by Stuart Baker (tom. cit., 1927, p. 63) seems to contain two poorly defined phenotypic populations. Birds from Sikkim and Darjeeling are somewhat small (wing ♂♀ 120-122, tail 57-64) and have lighter, less distinct patterns of transverse bars on the back and wing coverts. This tendency reaches its culmination in the larger *humei* to the west. This colour effect spreads to N. Cachar and Margherita in Upper Assam where three out of a total of six specimens exhibit this difference. Below there is little to choose between the two populations although the throats of Sikkim and Darjeeling birds seem more uniformly marked, less streaked. One of two specimens from the Arakan (type locus of *phaioceps*) exhibits the same paling out. Otherwise birds from the Mishmi Hills, Patkoi Hills, and the rest of this race's range in Burma (Pegu Yomas, Myitkina area etc.), are all more strongly marked on the upper parts and tend to be larger (wing ♂♀ 122·5-134·5, tail 60·5-73·5).

Dendrocopus macei macei (Vieillot) : Fulvous-breasted Pied Woodpecker.

Three females were taken at Sadiya, Tezu and Dening. They measure : wing 107-108 ; tail 63-55.5 ; culmen 23-24.5. Soft parts : iris brown ; bill brownish-grey; feet dark grey.

Although western Himalayan birds are larger (wing up to 118) the race *westermani* does not seem worthy of recognition.

Mulleripicus pulverulentus : Great Slaty Woodpecker.

Both authors saw this species at Tezu in December and January. R. stalked a party of five which were together in the top of an immensely tall tree on the edge of a dry riverbed in dense jungle. No specimens were secured. The birds have a variety of loud calls which SA describes as something astoundingly between the bleat of a goat and the bark of a dog !

Picumnus innominatus malayorum Hartert : Malay Speckled Piculet.

A female from Dening in fresh plumage collected January 8 seems to belong to this race. When compared with other specimens taken at similar periods the differences between *innominatus* and *malayorum* seem slight indeed. This female and a female from Laukkaung, E. Burma in the A. M. N. H. coll. taken in November both have a rather purer olive greenish tint on the crown than birds from either Sikkim (*innominatus*) or Annam (*malayorum*). The tone of the underparts also seems richer, more yellowish.

Sasia ochracea ochracea Hodgson: Indian Rufous Piculet.

A male and female were shot at Sadiya and Dening. They measure: wing ♂ 51·5, ♀ 54; tail ♂ 23, ♀ 21; culmen ♂ 14, ♀ 13. Soft parts: iris and ocular skin crimson red, pale magenta; bill, upper mandible black, lower light gray; legs yellowish brown.

The above male and another from Pyepat, E. Burma in the A.M.N.H coll. seem slightly darker on the crown and nape than typical *ochracea*. The material is too small, however, to see whether this tendency is upheld. I fail to see characters which distinguish the race *querulivox*. Southern Burma specimens (*reichenowi*) seem inseparable from Cachar birds.

Restless habits. Flits about in dense secondary growth, clinging momentarily to looping and twining creeper stems and tapping with bill. Sometimes hops amongst debris of decaying twigs close to the ground with the absurd stub tail cocked-up like a wren's.

EURYLAIMIDÆ

Psarisomus dalhousiae dalhousiae (Jameson): Long-tailed Broadbill.

Specimens of this Broadbill, collected at Tezu and Dening in December and January, measure: wing 101-104·5. Soft parts: iris brown, inner ring pale brown; eyelid chartreuse green; bill, upper mandible greenish, lower mandible greenish with orange areas on the base and a pale bluish green tip; legs yellowish olive-green.

These birds were flocking in bamboo clumps, flitting from tree to tree in disorderly 'follow-my-leader' style, rather like minivets. The perching stance is also upright like a minivet's. An occasional single note *sweet*, of the timbre of that of *Saxicoloides fulicata* was heard. Stomachs of 4 examined contained large blackish-brown ants, bugs and spiders exclusively.

Serilophus lunatus rubropygius (Hodgson): Hodgson's Broadbill.

Eleven males and females collected at Tezu measure: wing 82·5-88, tail 65·5-71; culmen 15-16·5. Soft parts: iris brown; ocular skin yellow; bill bluish-slate, external nares and patch on lower mandible yellowish-green. Or: sub-orbital skin bright yellow; upper mandible blue with pale edges and tip; lower mandible blue at base, yellowish-green on gonys; legs and feet bright yellowish-green; claws plumbeous.

Nine of these birds were caught one night in a bird net. They made a loud mouse-like squeaking when disturbed or alarmed.

PITTIDAE

Pitta nepalensis nepalensis (Hodgson): Blue-naped Pitta.

Males were taken at Tezu and Dening. They measure: wing 120-122; tail 55·5, 65; culmen 30, 31. Soft parts: iris brown; eyerim pale salmon; bill horny-brown, paler at tip; legs and feet brownish-flesh, claws paler.

The Dening specimen is darker on the breast and in the tone of the upper-parts than any specimen of this variable race examined. Above, it is similar to *heudeei* but it is even darker than specimens of this race, on the breast.

At Dening we came upon one of these birds feeding on cow manure, that is, picking it apart evidently looking for insect life. Progresses on ground by long hops, like thrush but more exaggerated. Silhouette in low cross flight from one thicket to another, very like waterhen (*Amaurornis*).

HIRUNDINIDAE

Hirundo daurica: Red-rumped Swallow.

Seen at Sadiya.

Delichon nipalensas Hodgson & Moore: Hodgson's House-Martin.

A specimen taken above Dening (ca 3500') has a wing measurement of 98. One of about 50 birds hawking insects over a ridge.

Riparia paludicola (?): Sand-Martin.

Noted at Sadiya.

MOTACILLIDAE

Motacilla alboides Hodgson : Hodgson's Pied Wagtail.

Specimens were taken at Sadiya and Tezu. Two black-backed males have wing measurements of 95, 105.

Motacilla alba personata Gould ; Masked Wagtail.

A female taken at Sadiya has a wing measurement of 90.

Anthus hodgsoni hodgsoni Richmond : Indian Tree- Pipit.

A number of specimens of this Tree Pipit were taken at Sadiya, Tezu, Dening and Dreyi, in November, December and January. All are in moderately worn plumage but which retains the olive tone of the feathers to a considerable degree. The perfection of the postnuptial moult is retained for only a short time. Soft parts : iris brown ; bill, upper mandible brown, lower grayish brown ; legs flesh, whitish flesh.

Anthus hodgsoni yunnanensis Uchida & Kuroda : Yunnan Tree-Pipit.

Three specimens of this very lightly streaked race were taken at Dening and Dreyi. All are in moderately worn plumage. [For details on the nomenclature of this species see Ripley, *J.B.N.H.S.*, 47 (4) pp. 622-7].

Anthus trivialis : Tree-Pipit.

Noted at Sadiya.

Anthus rufulus : Indian Pipit.

Seen but not collected at Sadiya by SA.

Anthus roseatus Hodgson : Hodgson's Pipit.

Two males were taken at Tezu. Their wing measurements are 91, 96.

CAMPEPHAGIDAE

Hemipus picatus capitalis (McClelland) : Brown-backed Pied Shrike.

Two males and a female were collected by SA at Sadiya. They measure: wing ♂ 63, 65 ; ♀ 62. These brown-backed males are extremely dark brown in tone, not infused with black.

Pericrocotus flammeus speciosus (Latham) : Indian Scarlet Minivet.

Four males and a female were collected at Tezu and Dening. They measure : wing ♂ 95·5-104·5 (101), ♀ 99; tail ♂ 96-102, ♀ 96·5 ; culmen ♂ 19-20, ♀ 20·5.

Deignan (*Auk*, 63, 1946, p. 511), has recently discussed the races of the Scarlet Minivet, and puts the Assam birds in *elegans* (McClelland). Compared with a fresh series from Nepal these birds are inseparable in size or of course colour. Our birds differ from his diagnosis in having small red tips on one rectrix each, and measuring larger. Furthermore Mr. Peters (in litt.) tells me that female specimens from the Chin Hills and the female co-type of *bakeri* (put into *elegans* by Deignan) have spots on the second primary and that male specimens in the collection at Harvard from the Chin Hills have entirely red outer webs on the central rectrices, thereby disagreeing with Deignan's discussion and description. All these small points of course would change Deignan's percentages for his racial characters.

Another point in reference to Deignan's paper is that he fixes the type locality of McClelland's *elegans* at Sadiya. Mr. Kinnear writes me (R) that McClelland's birds were collected in the Khasia Hills or in the plains to the *south* of the Hills. This is a fairly important point as the Khasia Hills are nearly two hundred and fifty miles southwest of Sadiya and across the Lohit River, the eastern fork of the Brahmaputra. Therefore, I believe that it would be preferable to refix the type locality of *elegans* (McClelland) to Shillong. By doing this it still seems possible to recognize the race and to emend its range as listed (l.c., p. 524) to ' Assam, except northeastern part and north of the Brahmaputra,' and to include that area in the range of *speciosus*.

Small parties of mixed sexes occasional. Not common.

Campephaga fimbriata melaschista (Hodgson) : Dark Grey Cuckoo-Shrike.

A male with a wing measurement of 121 was taken by SA at Tezu.

Coracina novaehollandiae nipalensis (Hodgson) : Large Himalayan Cuckoo-Shrike.

A male taken at Sadiya has a wing measurement of 183.

Utters harsh parrot-like cries from tree-top accompanied by a comical alternate jerking of wings—once right once left—for several minutes at a time.

LANIIDAE

Lanius schach nigriceps (Franklin) : Indian Black-headed Shrike.

Collected at Sadiya and Tezu. Three males measure: wing 98, 98, 100. Soft parts: iris dark brown; bill black, base of bill light gray. This species was also seen as high as Dreyi.

Lanius tephronotus (Vigors) : Grey-backed Shrike.

Four males and a female were taken at Sadiya, Tezu, Dening and Dreyi. They measure: wing ♂ 98–101, ♀ 102·5.

I prefer to follow the treatment of Dunajewski (*Jour. f. Ornith* 1939, 87, p. 28) as cited by Mayr (*J.B.N.H.S.*, 1947, 47, p. 125), and retain the name *tephronotus* for the gray-backed breeding bird of Tibet as Stuart Baker originally did (tom. cit., 1924, p. 297), probably by inadvertence (R).

PYCNONOTIDAE

Aegithina tiphia tiphia (Linnaeus): Iora.

A female taken at Tezu measures: wing 65, tail 59, culmen 17. Soft parts: iris whitish gray; bill slate gray, culmen black; legs slate gray. This bird seems slightly more saturated with greenish on the breast than three females from Bengal.

Chloropsis hardwickii Jardine & Selby: Orange-bellied Chloropsis.

Ten specimens were taken at Tezu, Dening and Dreyi. They measure: wing ♂ 93–98 (95·5), ♀ 89·5–92 (91·1); culmen ♂ 21–24·5 (22·3), ♀ 22–25 (23·5).

Birds to the east of Sikkim seem somewhat richer green in the colour of the upper parts, particularly the back.

Inseparable from parasitic *Loranthus* clumps infesting forest trees. Springs open buds and probes the flower tubes for nectar. Evidently an important agent in cross-pollination.

Criniger flaveolus (Gould) : White-throated Bulbul.

Four males, two females and one sex indet. were taken at Sadiya, Tezu and Dening. The species was also noted at Dreyi. These birds measure; wing ♂ 101–106, ♀ 100, 101; culmen ♂ 20–25·5 (22), ♀ 21, 23. Soft parts: iris brown; bill whitish gray, grayish slate; legs yellowish white (1), fleshy brown, yellowish brown, greyish brown.

One male has the appearance of a very old cage bird although it was shot in heavy jungle at Tezu. The feet are scaly and the bill, particularly the upper mandible, is greatly proliferated. There is a tendency for birds from N.E. Assam, particularly the Mishmi Hills, to be slightly darker on the crown than Indian Himalayan birds. Two of the Mishmi series are very dark rusty brown on the back.

Noisy parties feeding on wild *Fici* and berries. Call notes: harsh, loud *Käk-käk*, etc. between call of *Turdoides terricolor* and cries of a frog caught by snake.

Microscelis madagascariensis nigrescens (Stuart Baker): Assam Black Bulbul.

Two males were taken at Dening and the species was observed from Tezu up to 6,000 ft. These specimens measure: wing 121·5, 125·5; tail 102·5, 111; culmen 27, 28.

This species is abundant in characteristic noisy flocks from 2,300 ft. up, but a preference for the tops of tall trees makes it a difficult bird to collect.

Microscelis flavala flavala (Hodgson): Himalayan Brown-eared Bulbul.

Nine males and seven females were collected at Tezu and Dening where it was most abundant. They measure:

	wing	tail	culmen
♂	94–105 (100.8)	84.5–94	19·5–22
♀	94·5–98 (97.2)	82.5–88	18·5–20

It will be noted that dimorphism in size evidently exists, although it is not usually mentioned in discussions of bulbul species.

These birds average a more smoky gray on the underparts than typical *flavala*. Soft parts: iris reddish, reddish-brown; bill and legs black. It was a noisy flock of these birds which first attracted me to *Glaucidium brodiei*.

Microscelis mcclellandi: Rufous-bellied Bulbul.

Three individuals of this species were seen in a tall tree on the road below Dreyi, but we failed to collect them. The brown underparts, white throat with projecting feathers and the slight crest were all apparent.

Pycnonotus striatus arctus Ripley: Eastern Striated Green Bulbul.

Eight males and five females were taken at Dreyi. These birds measure: wing ♂ 110–118, ♀ 109–114; culmen ♂ 19–21·5, ♀ 18·5–20. A fresh series of Nepal birds measures; wing ♂ 107–114, ♀ 104·5–107; culmen ♂ 17–18·5, ♀ 17–17·5. Soft parts: iris reddish brown; bill black; legs blackish brown. A juvenal males was taken January 2.

Compared to topotypical Nepal birds, these specimens not only are slightly larger, but also have darker, more pronounced tips to the feathers of the crown and darker shading on the crest feathers. The white shaft streaks tend to be somewhat narrowed on the back, and margined with darker olive green. The blackish shading on the tail is more intense. Below, the blackish shading on the breast feathers is darker and heavier and is carried farther down onto the abdomen.

Quite common from about 3500 ft. elevation up. Flocks of 6–15 birds 'follow-my-leader' from tree to tree. Typical bulbul call-notes, but easily distinguished from those of *P. jocosa* or *P. cafer*.

Pycnonotus dispar flaviventris (Tickell): Black-crested Yellow Bulbul.

A male was taken at Tezu and the species was noted at Sadiya. The wing measurement is 94 and the iris is listed as creamy-yellow.

Pycnonotus jocosus monticolus (McClelland): Assam Red-whiskered Bulbul.

Six males and one female were collected at Sadiya, Tezu and Dening. They measure: wing ♂ 89–95, ♀ 91.

Birds from northern Assam (Margherita and the Mishmi Hills), tend to be darker, more saturated on the upper parts than typical *emeria*. This species is very common in the Mishmis in suitable areas of clearings near villages. Flocks of over one hundred were seen associated with *P. cafer*. Absent at elevation of Dreyi (5,000 ft.)

Pycnonotus cafer bengalensis ≷ burmanicus: Red-vented Bulbul.

Birds from Tura, Assam, the Patkoi Range and the Mishmi Hills seem intermediate between *bengalensis* and *burmanicus*. They have black descending onto the back of the neck and breast as in *bengalensis*, but broad pale edges to the feathers as in *burmanicus*. On the underparts the blackish shading seems to be more extensive, as in *bengalensis*. This species has not been recorded before from north of the Brahmaputra.

Equally common and abundant with *P. jocosus* at lower elevations. Absent at Dreyi (5,000 ft.)

CINCLIDAE

Cinclus pallasi dorjei Kinnear: Bhutan Brown Dipper.

A single Dipper was procured along the banks of the Tebang, a branch of the Lohit River below Dening about 1400 ft. altitude. There was what seemed to be a family group on this stream. Elsewhere the species was not seen.

This specimen which measures: wing 97·5, culmen 22·5, seems to agree well with Bhutan specimens in the British Museum collection.

MUSICAPIDAE

Subfamily *Turdinae*

Saxicola torquata przewalskii (Pleske) : Turkestan Bush-Chat.

A male taken at Sadiya by SA Nov. 26 belongs to this race. It measures ; wing 71, culmen 15.

This is apparently an uncommon species, found in high grass and paddy crops, seen occasionally as single birds. This subspecies has also been obtained in the Abor Hills (Baker: Rec. Ind. Mus., VIII, pt. III, No. 19, 1913, p. 276.)

Saxicola ferrea G. R. Gray : Dark-grey Bush-Chat.

Specimens were taken at Sadiya, Dening and Dreyi. Like the preceding species these birds are uncommon but were usually noted in pairs, and SA notes they tend to keep always in the same area day after day.

Enicurus schistaceus Hodgson: Slaty-backed Forktail.

Seen on every rocky torrential stream above 500 ft. Specimens were taken at Tezu and Dening. They measure: wing ♂ 100, ♀ 96, 97. Soft parts: iris brown ; bill black ; legs white, whitish gray.

Enicurus scouleri scouleri Vigors: Little Forktail.

The Little Forktail was found on the Tebang River and noted repeatedly on small rocky streams near Dreyi. A female and one sex indet. have wing measurement of 72·5, 76·5. This species may occur on much smaller streams than its larger relatives, provided the forest overmantel is sparse and open.

Phoenicurus frontalis frontalis Vigors : Blue-fronted Redstart.

A male and a female taken at Dreyi measure: wing ♂ 88·5, ♀ 84·5. They were found near open pasture in a damp swale.

Phoenicurus auroreus leucopterus Blyth : Daurian Redstart.

Specimens were taken by SA at Sadiya and Tezu. The Daurian Redstart was not a common bird and was seen very locally, haunting the same spot day after day, in pairs.

Phoenicurus hodgsoni (Moore) : Hodgson's Redstart.

A male and female of this Redstart were taken at Tezu. The female in the field is much paler than the Blue-fronted Redstart.

Chaimarrhornis leucocephala (Vigors) : White-capped Redstart.

Three males of this striking species were taken at Paya, between Sadiya and Tezu, and on the Tebang River below Dening. Their wing measurements are 91, 97·5, 99. Birds were observed singly on the edges of large swift-running rocky streams.

Rhyacornis fuliginosus fuliginosus (Vigors) : Plumbeous Redstart.

The Plumbeous Redstart was taken at Tezu and on the Tebang River where it was the most common of the Forktails or Redstarts. A male and two females measure wing ♂ 74, ♀71 (2).

Calliope tschebaiewi Przewalski : Tibet Rubythroat.

A male with a wing measurement of 69 was taken by SA at Sadiya, November 27.

Tarsiger cyanurus rufilatus (Hodgson) : Red-flanked Bush-Robin.

A female with a wing measurement of 81 was taken at Dreyi on January 2. This is a forest bird and this particular example was taken in a net.

Myiomela leucura (Hodgson). White-tailed Blue Robin.

Three males were collected at Dening and a female at Tezu. The males measure : wing 89, 93, 95, the female 89. Soft parts : male, iris brown, bill and legs black ; female, iris brown, bill horn, legs brown.

Feeds on ground in undergrowth. Hops onto stems and branches when disturbed.

Copsychus saularis saularis (Linnaeus). Magpie-Robin.

A male was taken at Sadiya and the species was seen at Tezu. This is an uncommon species in the area. Wing 97, bill (from forehead) 23.

Turdus atrogularis atrogularis Temminck: Black-throated Thrush.

The female was collected out on the open meadow at Dreyi on January 3. It measures: wing 136·5.

Zoothera dauma: Mountain-Thrush.

Seen at Dreyi on an open track in the forest.

Monticola solitaria pandoo (Sykes): Indian Blue Rock-Thrush.

A male taken at Dening (December 26) measures: wing 111·5.

Myiophoneus caeruleus eugenei Hume: Burmese Whistling-Thrush.

A male Whistling-Thrush taken at Dening on December 29 has no white tips to the wing coverts. This is the first record for this Burmese race in Assam although Mayr (Ibis, 1938, p. 294) notes that upper Chindwin specimens of *temminckii* are approaching *eugenei*. Curiously, an Abor specimen, (Baker, tom, cit., 1913, p. 278) is listed as characteristic *temminckii*. This bird measures: wing 172·5, tail 125, culmen 31·5.

This species, which was also seen at Dreyi, was very shy as always, keeping to the forested scrub and only coming into the open along water-courses and roadside clearings in the evening. It was not heard singing.

Subfamily *Timaliinae*

(For the order followed see Delacour, L'Oiseau, *XVI*, 1947, p. 22.).

Pellorneum ruficeps pectorale Godwin-Austen: Mishmi Spotted Babbler.

Three males and a female were collected at Tezu in December and January. They measure: wing ♂ 74, 75, 76, ♀ 71; culmen ♂ 19, 20 (2), ♀ 18. Soft parts: iris brown; upper mandible horny brown, lower, yellow at base, pale horn at tip; legs flesh. Deignan (Smith. Misc. Coll., 1947, *107*, No. 14), has reviewed the races of this species and made a number of nomenclatoral changes. This subspecies is by all odds the darkest and most distinctive of the entire species and highlights the interesting tendency of the avian fauna in the Mishmi area to be darker, more saturated in color than its adjacent relatives.

In early morning and at dusk this species was heard calling the plaintive *beat-you* in its characteristic familiar way. Pairs were met in small clearings on either side of the road north to Dening, in the dense evergreen forest, hunting among the weeds and ground cover.

Pellorneum albiventre ignotum Hume: Assam Babbler.

Taken at Tezu. Two males have wing measurements of 59, 60, and one culmen measurement of 15. This race has now been collected as far west as Bhutan (see Ludlow and Kinnear, Ibis, 1937, p. 36), but the Chin Hills specimen mentioned is probably true *albiventre*.

A skulker, the Assam Babbler behaves exactly like the Spotted Babbler, and is found in much the same facies. It utters a sharp *chick* from time to time, which betrays its presence in dense thickets of weeds, etc.

Malacocincla tickelli assamensis (Sharpe): Austen's Babbler.

A male taken at Dening (December 26) measures: wing 62, tail 51·5, culmen 16. Soft parts: iris reddish brown; bill, upper mandible dark brown; legs brownish-gray.

This single specimen is slightly darker above and paler, less buffy below than five specimens taken on the upper Chindwin.

Pomatorhinus montanus sálimalii Ripley: Mishmi Slaty-headed Scimitar Babbler.

Two males were taken at Sadiya and Tezu. They measure: wing 94, 97; tail 95, 99·5; culmen 31, 33. Soft parts: iris pale red; bill, upper mandible black at base, yellow distally, lower yellow; legs brown, feet gray.

This race has a darker more blackish cap and rich dark black ear coverts compared to *schisticeps*, and is darker rufescent and with darker wing coverts and edges of the feathers of the wing than *cryptanthus*. In size this race is roughly intermediate between *schisticeps* and *cryptanthus*.

The bird from Tezu was taken in a thick patch of underbrush on the edge of a dry river bank. It was one of a flock of mixed *Pomatorhinus* and *Gampsorhynchus*. The birds were silent but made an audible rustling noise as they worked through the bushes. Only when I fired at one bird, did the whole flock, one after another dart across the river into some thick bamboo scrub, making their characteristic hollow rolling notes as they went. Their calls are almost identical with those of *Pomatorhinus horsfieldi* of peninsular India.

Pomatorhinus erythrogenys macclellandi Jerdon : McClelland's Scimitar Babbler.

A female collected at Sadiya measures: wing 87, tail 90, culmen 33·5. Soft parts: iris pale straw; bill horny-brown, darker at base; legs and feet brownish-flesh.

This bird called with squeaky alarm notes indistinguishable from those of other Scimitar Babblers.

Pomatorhinus ochraceiceps stenorhynchus Blyth : Austen's Scimitar Babbler.

Two males and a female taken at Dening belong to this race. They measure: wing ♂ 90, 94, ♀ 85; culmen ♂ 37, ♀ 31·5. Soft parts: iris brownish-gray (biscuit colour); bill orange, nares brown; legs and feet yellowish-brown, greenish-brown or olive.

The type locality of this subspecies is Sadiya, and as Dening is also north of the river (the Lohit) and only forty miles east and slightly north of Sadiya I presume that these specimens belong to the race *stenorhynchus*. If this be true it is necessary to realign the ranges of this race and *austeni*. The race *stenorhynchus* is paler below than *austeni*, more whitish on the breast and center of the abdomen. It also tends to be smaller. Two ♀♀ from the upper Chindwin agree with the Dening ♀ in size and color. They measure: wing 84, 86, culmen 31.5, 35. They are the birds discussed by Mayr (Ibis, 1938, p. 287). The race *austeni* from Manipur, also occurs in the Naga Hills, Margherita, and North Cachar[1]. These birds besides being darker below are larger. A series from these localities measure: wing 84-92, (89·1) culmen 31-36·5 (34·2). Five females from Myitkyina agree in color perfectly with the specimens examined of *stenorhynchus* but are larger: wing 88-91.5, culmen 34-38. As *stenorhynchus* was described on the basis of color not size, the Myitkyina birds should be included in that paler race bearing in mind that they probably represent an emergent separate population. The races of *ochraceiceps* should be listed as follows:

Pomatorhinus ochraceiceps stenorhynchus

Range: Assam, Mishmi Hills; Burma, Upper Chindwin, and Myitkyina.

P.o. austeni

Range: Assam, N. Cachar, Margherita, Naga Hills, Manipur; probably lower Chindwin area of Burma.

P.o. ochraceiceps

Range: Burma, Shan States, Karen Hills, Karenni; Mountains of Tenasserim.

Frequent. In parties of 6 or 7 probing into flowers of forest trees for nectar. In the distance this species presents a very slim and long-tailed profile.

Xiphirhynchus superciliaris intextus Ripley : Assam Slender-billed Scimitar Babbler.

A single female, the type of this race, was taken January 6 at Dreyi in low but very thick secondary scrub. It was caught alive in a bird net and

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[1]Stanford and Ticehurst (Ibis, 1938, p. 100) were writing about two populations of the same race (=*austeni*), apparently not realizing that the type locality of *stenorhynchus* is far removed from the Naga Hills.

no other specimens were seen. It measures: wing 77, tail 84; culmen 55. Soft parts: iris red; bill black; legs slaty-brown; feet bluish-gray, pads yellow. The stomach contained a slightly viscous milky-white liquid. In coloration, *intextus* from the Mishmi Hills and Manipur is paler than *superciliaris* and darker, more richly colored than *forresti.*

Turdinus brevicaudatus striatus Blyth: Streaked Wren-Babbler.

A male was collected in a bamboo clump at Dening December 29. It represents the first record of this species north of the Lohit arm of the Brahmaputra. It measures: wing 59·5, culmen 16. Soft parts: iris brown; bill dark brownish horn; legs brownish flesh. Alarm note, a loud *tsik.*

This specimen agrees with birds from Margherita except that the dark edges to the feathers are blackish rather than dark rufous-brown, and below the flanks and spots on the breast are dark olive-brown rather than ochraceous tawny. It would be difficult to say how much such changes are due to foxing.

Pnoepyga pusilla pusilla Hodgson: Brown Wren.

A female taken at Dening measures: wing 49, culmen 10·5. Soft parts: iris dark brown; bill, upper mandible blackish, lower grayish horn; legs dark brown.

This specimen was shot by SA in thick undergrowth. It has the same restless acrobatic habits as *Tesia.* It flicks its wings frequently and nervously like a willow-warbler, and makes a feeble *tsik, tsik* noise.

Spelaeornis badeigularis Ripley: Mishmi Wren.

A single adult female, the type, was collected at Dreyi in a bird net on January 5. It measures: wing 48, tail 31, culmen 11·5. Soft parts: iris brown, bill black, legs brown.

This is a shy skulking bird which probably occurs throughout the Hills in a much larger area than at present known. Its nearest relative is *Spelaeornis caudatus* from Darjeeling, Sikkim and Bhutan, from which it differs in having a white chin, dark chestnut throat and widely barred breast, abdomen and under parts. In size it is about the same, but has noticeably shorter tail coverts. (See coloured plate.)

Stachyris rufifrons ambigua (Harington): Harington's Red-fronted Babbler.

Three males were collected at Sadiya and Dreyi. They measure: wing 54-56. Soft parts: iris brown, bill bluish horn; legs greenish yellow. Old specimens fox and fade so rapidly that old material in collections is valueless for comparison.

Common in small mixed flocks of babblers, creeping through undergrowth.

Stachyris chrysaea chrysaea Blyth: Nepal Golden-headed Babbler.

Three males and a female taken at Dreyi measure: wing ♂ 51-56, ♀ 51. This was quite a common species in the mixed flocks of babblers, flycatchers and warblers which swept at times through the substage in the dense forest about Dreyi.

Stachyris pyrrhops: Red-billed Babbler.

Observed at Sadiya. Some of its whistling calls are reminiscent of an iora's.

Stachyris nigriceps nigriceps $\geq$ **spadix**: Black-throated Babbler.

Three males and five females collected at Sadiya, Tezu, Dening and Dreyi measure: wing ♂ 59-62. 5, ♀ 58-62. Soft parts: iris brown; bill, upper mandible black, lower grayish horn; legs dull greenish yellow.

Birds from the Mishmi Hills are somewhat intermediate between *nigriceps* which ranges from Nepal to the Miri Hills, and *spadix* from Cachar and the Chin Hills (Mt. Victoria). In this case, the Mishmi Hills population does not seem as close to birds from Margherita as happens in so many other species. The ear coverts of these birds are brownish-fuscous, more brownish than *nigriceps*, less pure brown than *spadix* and not rufous-brown as in *coltarti.* Specimens of *coltarti* have been examined from Margherita (type locality), Naga Hills (Mokokchung), and North Burma south to Bhamo.

These birds appeared at all altitudes in mixed hunting parties in dense undergrowth. We found them associated with *Stachyris rufifrons* and *Schoeniparus rufigularis*.

Macronus gularis rubricapilla (Tickell) Yellow-breasted Babbler.

Two males and one sex indet. were taken at Sadiya and Dening. They measure : wing ♂ 55, 57, 0?55. These are richly colored examples.

The Yellow-breasted Babbler was not uncommon in flocks among the canopy of foliage. Its habits are similar to *Stachyris* and other small babblers.

Timalia pileata bengalensis Godwin-Austen : Bengal Red-capped Babbler.

A male was collected at Sadiya November 27. It measures : wing 62 culmen 19. It is moulting wing and tail feathers.

Paradoxornis poliotis poliotis (Blyth) : Blyth's Suthora.

A male, two females and one sex indet. were taken at Tezu and Dreyi. This is an extension of range for this race which has not been previously recorded from the Mishmi Hills north of the Brahmaputra.

Flocks of about thirty or more were seen fleetingly working through bamboo clumps high up, with great rapidity. The birds literally flow after each other in a constant undulating procession. Sometimes they may be seen, perched together side by side on a branch, looking rather like miniature Munias at a distance.

Paradoxornis ruficeps atrosuperciliaris (Godwin-Austen) : Black-browed Suthora.

A single male was collected at Dening. It has a wing measurement of 74. Soft parts : iris reddish-brown ; bill pinkish-flesh ; legs and feet plumbeous.

Small parties of six to eight were seen hunting vigorously in bamboos behaving rather like tits or Yellow-eyed Babblers.

Garrulax moniliger badius Ripley : Mishmi Necklaced Laughing-Thrush.

A male, the type of the race, was taken at Tezu on January 11, and two other males at Sadiya and Tezu. They measure : wing, 120, 123, 124·5. Soft parts ; iris whitish-orange, orange-yellow ; bill black, tip light gray ; legs light gray.

These birds go about in flocks in exactly the same way as the next species. They are somewhat shy, and usually silent and secretive if people are about. However, once they fancy danger has passed, they utter a noisy chorus of hollow-sounding musical whistles.

Garrulax pectoralis uropygialis Bonaparte : Mishmi Black-gorgetted Laughing-Thrush.

Three males and two females were procured at Sadiya and Dening. They measure : wing ♂ 140 (2), 147 ; ♀ 140, 148 ; culmen ♂ 32, 34, 35·5, ♀35, 35. Soft parts: iris reddish-brown ; bill, upper mandible blackish-brown; lower basally gray, distally brown ; legs slate gray ; ocular area yellowish-flesh.

Birds from Sikkim, Darjeeling, Bengal, Assam and North Burma tend as a whole to be darker and richer on the upper and lower surfaces than do typical Nepal birds. In most areas of this range the darker color shows an olive tint, but in Margherita, the Patkoi Range and nearby North Burma on the Upper Chindwin, and in one of the two specimens from the Mishmis there is a strong dark rufous suffusion on the upper and lower parts. In such a variable species in which individuals may have blackish or whitish ear coverts, and may vary considerably in the width of the breast band and the depth of buff to rufous color on the lower parts, I should hesitate to describe this rufous population especially as there are individual variants among the Mishmi birds and among the three Margherita specimens. Ticehurst points out (Ibis, 1938, p. 93), that *moniliger* and *pectoralis* tend to breakup into races in the same areas. In this case *pectoralis* certainly shows exactly the same tendency as the preceeding species.

The name *uropygialis* Bonaparte (1850) is available for this race, as Arakan birds, called *melanotus* Blyth (1843), are light colored and belong with *pectoralis pectoralis*.

Like *moniliger*, this Laughing-Thrush goes about in troops, now silent at the approach of humans, now cackling and calling. They sit quite quietly in a bush so that they cannot be seen, and then if they must cross an open space, they have a way of flowing, the whole flock gliding one after another in a continuous streaming motion.

Garrulax striatus austeni (Oates): Austen's Striated Laughing-Thrush.

Birds from Dreyi and the Tidding Saddle measure: wing 143-148. Soft parts: iris reddish brown; bill blackish brown; legs grayish brown. These specimens were collected high up in original forest, and do not seem normally to come down as low to or on the ground as other laughing-thrushes.

I would put these specimens in with *austeni* although the crown and back are a bit darker, the coronal bands somewhat more prominent, and the bill seems a bit larger. They approach *cranbrooki* in these respects and in fact seem somewhat intermediate between the two.

Garrulax leucolophus leucolophus (Hardwicke): Himalayan White-crested Laughing-Thrush.

A single male was taken at Tezu. It measures: wing 132, culmen 28·5. Soft parts: iris reddish-brown; bill black; legs, feet and claws plumbeous. Stuart Baker (l. c. 1913, ix, p. 252), remarks that Mishmi birds exactly resemble typical *leucolophus*.

The White-crested Laughing-Thrush was taken from a flock of about twelve in dense bamboo jungle in company with *G moniliger*.

Garrulax ruficollis (Jardine and Selby): Rufous-necked Laughing-Thrush.

Males and females taken near Sadiya measure: wing 98–100, Soft parts: iris crimson, brown; eyelids yellow; bill and legs dark brown. Flocks were seen in rather open growth near clearings. This does not seem to be a bird of dense forest.

Garrulax squamatus (Gould): Blue-winged Laughing-Thrush.

A female taken at Dreyi measures: wing 98. Soft parts: iris white; bill dark brown; legs brownish flesh. This is a real skulker, keeping close to the ground in dense undergrowth. It has a thrush-like *chuck* call.

Garrulax subunicolor (?) **subunicolor** (Blyth): Plain-coloured Laughing-Thrush.

A single male of this laughing thrush was collected at Dreyi on Christmas Day. It measures: wing 99, tail 120, culmen 20. Soft parts: iris straw; bill blackish-brown; legs horny brown.

One of us (SA) found flocks of up to 20 quite common at the elevation of Dreyi. A week later the other party could not find the species!

The question of whether to recognize the race *griseata* Rothschild is still an open one. This specimen is darker more slaty on the crown, than Sikkim or even Burma birds, but as Mayr (Ibis, 1941, p. 62) points out, these differences could vary with age. I can find no significant difference in size between east and west populations.

Garrulax erythrocephalus imprudens Ripley: Ripley's Red-headed Laughing-Thrush.

A single specimen of this race was taken near the Tidding Saddle above Dreyi on January 6. It was in the open on a heap of freshly cut brush besides the trail, presumably attracted there and away from its usual dense and thicketed haunts by the small swarm of insects that had been drawn to the sap of the cut brush stems. It has a wing measurement of 101·5. The soft parts were noted as: iris brown, bill black; legs brown.

This race is very close to *nigrimentum*, but considerably darker, more olive-colored with a more orange-golden wash on the tail and wings. It is found in the Miri, Dafla and Mishmi Hills.

Liocichla phoenicea phoenicea (Gould): Assam Crimson-winged Laughing-Thrush.

A single male secured at Dreyi measures: wing 89, tail 92, culmen 18·5. Soft parts: iris brown; bill black; legs brown. The bird was skulking in a

dense thicket of secondary growth with another, possibly a mate, and was flushed out and driven into a net by my Naga porters. It fluttered over the ground and low roots and branches swiftly, half running, half flying, so that I (R) had no chance to shoot at it. A second drive the next day trapped the other bird in the same way, but she escaped from the net before I could grasp her.

This specimen and others from the Miri and Dafla Hills in the British Museum collection seem somewhat intermediate between *phoenicea* and *bakeri*, but are closer to the former. Taken together they seem very slightly paler than the typical race. The race *bakeri* has slightly different proportions than *phoenicea*. The tail is longer. It approaches *ripponi* in this and in its paler colours and I do not, therefore, agree with Delacour (l.c. p. 29) that the latter should be maintained as a separate species.

Leiothrix argentauris gertrudis Ripley; Mrs. Legendre's Silver-eared Mesia.

Two males and a female of the Silver-eared Mesia were taken at Tezu and Dening. They measure: wing ♂ 75,79, ♀ 74·5; culmen ♂ 15 (2), ♀ 14·5. Soft parts: bill, legs and feet yellow.

This race was named as being more yellowish on the nape and olive-greenish on the back, less reddish on the throat and more olive on the flanks than typical *argentauris*. It is a larger form than *vernayi*. The range of this race appears to be the Mishmi Hills and northern Burma in the Myitkina area and east across the Irrawaddy in the Triangle.

Pure flocks of 30 and more searching actively for insects amongst the foliage of shrubs as well as up in forest canopy. Makes occasional flycatching sallies in the air, but behaviour mostly tit-like. Clinging to sprigs in acrobatic positions and peering under leaves. Hastily moving on from tree to tree. Very shy: the troop diving into bushes or 'flowing' across to another tree in disorderly follow-my-leader fashion even when the observer is still a considerable way off.

Pteruthius erythropterus (Vigors): Red-winged Shrike-Babbler.

Two male shrike-babblers were collected at Tezu. They measure: wing 83, 84. Both these birds are more vinaceous on the flanks than western Himalayan birds and they also tend to be darker gray on the upper surface. Soft parts: iris bluish gray, deep blue; bill, upper mandible black, lower plumbeous, or grayish-blue; legs dark flesh, brownish-flesh.

Pteruthius melanotis melanotis Hodgson. Chestnut-throated Shrike-Babbler.

Two females of the little Chestnut-throated Shrike-Babbler were collected at Tezu. They were in a large mixed flock of small birds high up in mixed trees, partly *Bombax* sp. They measure: wing 56, 58, culmen 10·5, 11. Soft parts: iris brown; bill upper mandible dark slate, slaty; lower gray, pale flesh; legs whitish-brown, pale fleshy-brown.

These two specimens have the moustachial streak dark cinnamon instead of chestnut, and the lesser wing coverts cinnamon instead of buff. They are also slightly darker above than specimens from Nepal and Sikkim.

Gampsorhynchus rufulus Blyth: White-headed Shrike-Babbler.

Two females were taken at Tezu and Dening and we saw several and shot another unfortunately decapitating it. They always seemed to be associated with Scimitar-babblers, usually in thick clumps often of bamboo. General appearance, flight and behaviour reminiscent of the bulbuls. These specimens have wing measurements of 97, 98. Soft parts: iris orange-straw; bill plumbeous, paler or lower mandible; legs, feet and claws flesh.

Actinodura egertoni lewisi Ripley: Lewis's Barwinged-Babbler.

A large series of this race was secured at Dreyi and on the Tidding Saddle. In size they equal typical *egertoni*, but are darker than that race with pronounced edging to the crest feathers, and without the barring on the tail found in *khasiana*. Soft parts: iris slaty-gray to brownish-gray; bill upper mandible horny-brown with a flesh colored tip, lower yellowish horn; legs brownish-flesh.

This species was one of the commonest seen above five thousand feet. It hunts in flocks not associating with other species as other babblers do. General habits very like laughing-thrushes. Call: a feeble *cheep*.

Siva strigula yunnanensis Rothschild: Yunnan Stripe-throated Siva.

Five males and a female taken at Dreyi have wing measurements of ♂ 64-63, ♀ 66. Soft parts: iris dark brown, bill dark brown, legs brownish-gray.

Securing these six specimens of the Stripe-throated Siva on the Tidding Saddle above Dreyi, marks a considerable westward extension of range for this subspecies which has only been recorded hitherto from Yunnan, the hills east of Myitkina and the Chin Hills in Burma. For notes on this race see Mayr (Ibis, 1941, p. 86).

These birds were in mixed flocks of babblers working through thick bamboo clumps and bushes with great rapidity.

Siva cyanuroptera cyanuroptera Hodgson : Hodgson's Blue-winged Siva.

One specimen (o?) with a wing measurement of 64 was taken at Dening. The Blue-winged Siva was not otherwise observed, except this one flock which was hunting through evergreen forest much like Mesias.

Yuhina flavicollis baileyi (Stuart Baker) : Mishmi Ixulus.

A pair of the Mishmi Ixulus was taken at Dreyi. They measure: wing ♂ 6·25, ♀ 63. Soft parts; iris brown; bill ♂ grayish-brown, ♀ brown; legs ♂ yellowish-brown, ♀ brownish-yellow.

As these specimens differ considerably from the original description (*B.B.O.C.*, 1914, xxxv, p. 17), it is worthwhile noting their appearance. Stuart Baker describes *baileyi* as having the crown and upper parts 'paler' than *flavicollis*. In fact these birds have pronounced dark chocolaty-brown crowns and crests. The back is tinted with dark olive and the nuchal collar is rich orange-rufous. All of this makes these birds darker than *flavicollis*. In addition I can see no significant differences in the color of the ear coverts of specimens of this and the nominate race. Below, these birds are washed (exclusive of the chin and throat) with rich creamy-buff.

Yuhina bakeri Rothschild : Baker's Chestnut-headed Ixulus.

A male and four females taken on the Tidding Saddle above Dreyi measure: wing ♂ 70·5, ♀ 67-69·5. Soft parts : iris brown, reddish-brown ; bill black ; legs brown, pads yellow.

Compared with Darjeeling birds, these specimens seem somewhat more olive colored on the back and with darker crowns. For comments on the species see Mayr. (Ibis, 1941, p. 91).

These Chestnut-headed Ixulus were in flocks together and reminded one of tits. They have a sharp single note.

Yuhina nigrimentum nigrimentum Blyth ; Black-chinned Yuhina.

A single female taken by SA at Dening measures : wing 59, tail 39·5, culmen 14. Soft parts: iris hazel brown ; bill, upper mandible horny-brown, lower and gape orange-red ; legs and feet orange-flesh.

This specimen was taken from a mixed flock of babblers. It hunts in the canopy of trees as well as in the lower shrubs.

Yuhina xantholeuca xantholeuca (Hodgson) : White-bellied Herpornis.

A male taken at Dening measures : wing 66·5, culmen 15. Soft parts : iris brown ; bill, upper mandible brown, lower whitish-gray ; legs whitish-grey. This specimen was taken from a mixed flock of babblers in heavy jungle.

Alcippe cinerea (Blyth) : Dusky-green Tit-Babbler.

A large series was collected from Dreyi up to the Saddle. With *Actinodura* this was the commonest of the babblers. This species formed the core of large flocks of mixed babblers, *Stachyris* being the next most common. Fantail flycatchers and sunbirds were also attracted into these associations.

Soft parts : iris brown ; bill, upper mandible horn, lower bluish-white ; legs pale yellowish horn. In size these birds seem similar to Sikkim and the Darjeeling specimens. Due to rapid fading, color is impossible to compare.

Alcippe castaneiceps castaneiceps (Hodgson) : Chestnut-headed Babbler.

A female from Tezu has a wing measurement of 55. Soft parts : iris brown ; bill horny-brown, yellow at gonys; legs and feet brownish-yellow.

Large restless flocks of this species were seen in bamboos and low thickets. It behaves similarly to *Suthora*, hunting feverisly in the foliage the flocks, moving quickly from tree to tree. It does not appear to be a mixer like many other babblers.

Alcippe rufogularis rufogularis (Mandelli) : Red-throated Tit-Babbler.

Two males and two females were taken at Tezu and Sadiya in thick underbrush, close to the ground. They are great skulkers creeping about through the tangle of stems and betrayed only by their chipping call *chree-chree*. Measurements : wing ♂ 55·5, 57·5, ♀ 56, 57·7; tail ♂ 46, 49, ♀ 46, 47; culmen ♂ 13, 13·5 ♀ 13, 14. Soft parts: iris brown; bill black; legs yellow.

Alcippe nipalensis commoda Ripley : Mishmi Quaker Babbler.

Two males, two females and one sex indet. were taken at Tezu and Dening. They measure : wing 57-61, tail 55-59, culmen 12-13·5. Soft parts : iris brown; bill, upper mandible basally brown, distally gray, lower mandible light gray; legs yellowish-brown.

These birds have shorter tails in proportion to the length of the wing than true *nipalensis*, and they are darker in plumage also.

Heterophasia pulchella coeruleotincta (Rothschild) : Beautiful Blue-gray Sibia.

Four males and a female of this lovely Sibia were collected at Dreyi and on the Tidding Saddle. They measure : wing ♂ 110-115, ♀ 100; tail ♂ 113-118, ♀ 108. Soft parts : iris brown; bill black; legs brown.

These birds were high up in the canopy of the original forest trees. No songs were heard, but they were noted feeding, moving about slowly on the outer branches. This is the first record for this Yunnan and north Burma subspecies in India.

Heterophasia picaoides : Long-tailed Sibia.

Flocks of these distinctive birds were noted at Dreyi and Dening and on the trail, but resisted efforts at collection. They have a rich whistling call of thrush quality, six notes ending in *wheet-whee* reminiscent in cadence of *Alcippe poiocephala*, but much louder.

SUBFAMILY SYLVIINAE

Orthotomus sutorius luteus Ripley : Mishmi Tailor-bird.

Specimens taken at Sadiya, Tezu and Dening have wing measurements from 43-48·5. Soft parts : iris pale brown ; bill dark brown ; legs flesh-colored. This race is somewhat more rufous-buff below than *patia* and the crown and nape are darker, the forehead richer rufous, than that subspecies.

These birds occurred wherever there were suitable patches of scrub near habitations. SA noted their voice and calls to be strikingly different from that of the Indian race *guzerata* from, say, the Bombay neighbourhood.

Prinia gracilis: Franklin's Wren-Warbler.

Seen at Sadiya.

Megalurus palustris Horsfield : Marsh Warbler.

A pair of these warblers (♂♀) were collected at Sadiya. Wing 85-95 ; culmen 19-21.

Common in tall grass and scrub on overgrown cultivation clearings in forest. Solitary and parochial habits. Usually shy and wild. Call : a drawn-out rather subdued whistle ending in a loud, percussive *wheeechoo*.

Phylloscopus affinis (Tickell) : Tickell's Willow-Warbler.

This species was collected at Sadiya. Wing of one specimen, sex undetermined, measures 60.

Phylloscopus maculipennis maculipennis (Blyth) : Gray-faced Willow-Warbler.

A male and two females taken at Dening in late December, measure : wing ♂ 50, ♀ 49, 49·5. Soft parts ; iris brown: bill black ; legs ♂ brownish-yellow, ♀ brownish-gray.

Phylloscopus magnirostris Blyth : Large-billed Willow-Warbler.

The diagnostic *Whee-chi* ? call was frequently heard at Tezu between 10 and 18 December.

Phylloscopus proregulus chloronotus (Gray): Himalayan Yellow-rumped Willow-Warbler.

A male and female were collected at Tezu and Dening in late December and January. They measure: wing ♂59, ♀51·5. Soft parts: iris brown ; bill ♂ dark brown, ♀ black ; legs ♂ dark brown, ♀ greenish-yellow.

Phylloscopus trochiloides: Green (or Greenish ?) Willow-Warbler.

The characteristic *chi-wee* call of either *nitidus* or *viridanus* was heard at Sadiya between November 19 and December 2.

Phylloscopus reguloides assamensis Hartert : White-tailed Willow-Warbler.

A male was taken at Sadiya on December 2. It has a wing measurement of 56.

Seicercus xanthoschistos pulla Ripley: Mishmi Gray-headed Flycatcher Warbler.

Two females and one sex indet. with wing measurement of 50, 50, 51 were taken of this darker, more slaty-colored race at Sadiya and Dening. Soft parts : bill, upper mandible dark brown, lower orange-yellow, yellow-ochre ; legs grayish-brown, yellowish-gray. SA noted the call to be easily distinguishable from that of the West Himalayan *albosuperciliaris*.

In the original description of this form (Proc. Biol. Soc. Wash., *61*, 1948, p. 106), the subspecies *tephrodiras* Sick (Orn. Monat. 47, 1939, p. 78), was not mentioned. This form was described from Mt. Victoria, Chin Hills. This was an oversight and it should be explained that *pulla* from the Mishmi Hills is darker than a series of topotypical *tephrodiras*, not only in the upper parts, but also in the presence on the flanks and thighs of a dark olive wash. The range of *pulla* as given in the original description should thus be emended to exclude the Chin Hills, as well as the Khasia Hills and Cachar which fit in better with *tephrodiras*. The range of *pulla* is hereby restricted to the Mishmi Hills, Lakhimpur and northern Burma.

Seicercus poliogenys Blyth : Grey-cheeked Flycatcher-Warbler.

Three males were collected at Dening and Dreyi. They measure : wing 51, 55. Soft parts: iris brown; bill, upper mandible black, lower horn ; legs yellow, feet brownish-yellow.

Abroscopus superciliaris drasticus Deignan : Margherita Yellow-bellied Flycatcher-Warbler.

Specimens were collected at Sadiya, Tezu and Dening. Soft parts : iris brown, bill black, lower mandible dark gray ; legs whitish flesh, yellowish flesh. These specimens are slightly darker than birds from Margherita (type locality of *drasticus*) following the dominant speciation trend of the area.

Abroscopus albogularis albogularis (Moore) : White-throated Flycatcher-Warbler.

A single specimen, sex undetermined, was taken at Dening on Christmas Day. It has a wing measurement of 44·5. Soft parts : iris brown ; bill, upper mandible brown, lower light grayish-flesh ; legs yellowish-brown.

Cettia pallidipes pallidipes (Blanford) : Blanford's or Sikkim Bush-Warbler.

One specimen, sex undetermined was collected at Tezu. It has a wing measurement of 47 mm. Skulks in dense evergreen undergrowth.

Tesia olivia (McClelland): Slaty-ellied Wren.

A male and female taken at Dening on the 29th and 30th of December, measure : wing ♂ 50·5, ♀ 47, culmen ♂ 13, ♀ 13. Soft parts : iris brown ; bill, upper mandible blackish, lower orange, yellowish towards tip ; legs and feet brown, pads olive-yellow. This male is darker below than any other specimen examined.

Ludlow and Kinnear (Ibis, 1937, p. 257) have discussed this species and *cyaniventer* comprehensively. The above specimens belong to the dark, lower altitude species, and were taken in underbrush at the edge of thick forest at about 2,000 feet altitude.

These little birds keep near the ground and are extremely restless; never still. They have an amusing habit of jumping back and forth along the same branch looking like a clockwork toy. Like other small wren-like birds, *Pnoepyga* for instance, they have a habit of clapping their wings up over their back. They have a most distinctive call, *tchirik-tchirik* apparently not an alarm note.

Tesia castaneocoronata (Burton) : Chestnut-headed Wren.

A single female taken at Dreyi in thick forest measures : wing 50, culmen 12·5. Soft parts : iris brown ; bill, upper mandible black, lower yellowish-horn at tip legs greenish-yellow.

Kinnear (Ibis, 1937, p. 261) gives measurements for Yunnan birds (wing 51-55 mm.) and Shan States birds (wing 52·56 mm.). A male from Yunnan in the American Museum collection has a wing measurement of 57. Tonkin birds measure from 47-56. In contrast to this 24 specimens from Rampur through Nepal to Assam, the Chin Hills and North Burma measure from 45-50·5 (48·2). Based on average size alone, I (R) would recognize *abadiei* Delacour and Jabouille and include the Shan States and S.W. Yunnan in its range.

Delacour (Ibis, 1942, p. 515), has proposed the new genus, *Chorotesia* for this species based on the characters of longer rectrices, narrower, less flattened bill, and conspicuously different color pattern. Following that author's later arrangements of other families or subfamilies, *Estrildinae* and *Pycnonotidae*, (Zoologica, *28*, 1943), and *Nectariniidae* (Zoologica, *29*, 1944) in which he sets up large aggregates of species grouped in subgenera, and considering the relative value of the characters involved, I should be inclined to make *Chorotesia* a subgenus, in Delacour's sense of the term, using it to describe an aggregate (in this case monotypic) differing from another aggregate at a level somewhat higher than the specific one.

These birds are shy and elusive but not quite as difficult to see as the preceding species. They have a chattering squirrel-or wren-like call.

Phyllergates coronatus coronatus (Jerdon) : Golden-headed Warbler.

A male taken at Dening has a wing measurement of 48. Culmen 16·5. General appearance and behaviour very like *Orthotomus sutorius*.

Subfamily Muscicapinae

Chelidorynx hypoxanthum (Blyth) : Yellow-bellied Flycatcher.

Nine specimens were collected at Sadiya, Tezu, Dening and Dreyi. They measure : wing 54-58. Soft parts : iris dark brown ; bill, upper mandible dark brown, lower yellowish-brown ; legs brown.

Fans and cocks tail and pirouets like miniature *Rhipidura*. Utters feeble *tsi, tsi* note like *Phylloscopus*. Flycatches at all heights from low brushwood to canopy of tall trees, 100 ft. or more from ground.

Rhipidura albicollis albicollis (Vieillot) : White-throated Fantail Flycatcher.

Seven specimens of this dark fantail flycatcher were taken at Tezu and Dening. They measure: wing 79, 80. Five of the birds are of the year and have not entirely lost their juvenal wing feathers, although the rest of the plumage seems to be adult in character.

The species was also noted at Sadiya and Dreyi.

Culicicapa ceylonensis : Grey-headed Flycatcher.

Seen at Sadiya but not collected.

Niltava grandis grandis (Blyth) : Large Niltava.

Two males and a female were collected at Dreyi in bird nets. These Niltavas apparently fly and skulk along close to the ground. They measure : wing ♂ 107·5, 111, ♀ 97. Two North Burma females and this specimen have rather paler blue neck patches than Sikkim or Cachar or Chin Hills birds. They are also more olive, less rufescent in tone.

Niltava macgrigoriae (Burton) : Small Niltava.

Three males and two females collected at Sadiya and Dening measure : wing ♂.63.5–64.5, ♀ 63.5, 64.

Niltava sundara sundara Hodgson : Indian Rufous-bellied Niltava.

Four males and a female taken at Sadiya, Tezu and Dening measure; wing 79-85. The orange-chestnut on the underparts of the males is very bright and rich in color.

Muscicapa parva ssp. : Red-breasted Flycatcher.

One seen at Sadiya.

Muscicapa unicolor unicolor (Blyth) : Pale Blue Flycatcher.

Two males and a female taken at Tezu and Dening measure : wing ♂ 82.5, 83, ♀ 76. Soft parts: iris dark brown; bill black, base of lower mandible gray; legs dark brown.

Muscicapa hyperythra hyperythra Blyth : Rufous-breasted Blue Flycatcher.

Two males collected at Dening measure: wing 60, 62.

Muscicapa solitaris leucops (Sharpe) : Sharpe's White-gorgetted Flycatcher.

A female taken at Dreyi has a wing measurement of 61.

Muscicapa melanoleuca melanoleuca (Hodgson) : Indian Little Pied Flycatcher.

A female with a wing measurement of 55 was taken at Sadiya. Except for its smaller size, the ♀ of this species is superficially a good replica of *Alseonax ruficaudus*.

Muscicapa thalassina thalassina Swainson : Verditer Flycatcher.

A male collected at Sadiya measures : wing 80, tail 63, culmen 14. The species was also noted at Tezu.

Muscicapa strophiata strophiata (Hodgson) : Orange-gorgetted Flycatcher.

Four males and a probable female (sexed as a male) were collected at Dening and Dreyi. One of these males is probably a young bird. The orange gorget is less well-developed and the wing is 10mm. shorter than the others. The rest of the plumage is identical.

Paridae

Parus major nipalensis Hodgson : Grey Tit.

A male of this species taken at Sadiya has a rather small wing measurement of 65.

Parus spilonotus : Black-spotted yellow Tit.

Noted at Dreyi.

Aegithaliscus sp.

A quick-moving flock was seen briefly one day at Dreyi.

Melanochlora sultanea sultanea (Hodgson) : Sultan Tit.

Three males and a female taken at Sadiya and Tezu measure : wing 103-108, culmen 16-17. Some specimens are moulting on the body in December. It was seen in small parties, and its peculiar hovering flight from branch to branch is reminiscent of an iora's parachuting display. It makes a rather nasal short *chick* note, while hunting amongst the foliage of tall trees.

Sittidae

Sitta castanea cinnamoventris Blyth : Cinnamon-bellied Nuthatch.

A male collected at Tezu measures : wing 84, culmen 21.5. The very heavy bill of this race as compared with *castanea* or *prateri* is an outstanding feature.

Sitta himalayensis Jardine and Selby: White-tailed Nuthatch.

A male taken at Dreyi has a wing measurement of 76. Soft parts: iris brown; bill, upper mandible black, lower bluish-white basally, black distally; legs olive brown. This bird was near the crest of the Tidding Saddle at 6,000 ft.

Sitta formosa Blyth: Beautiful Nuthatch.

Two females shot above Dreyi measure: wing 98, 99.5, culmen 20, 21.5. In color they appear very slightly paler below than a single bird, sex undetermined, in the collection of the American Museum from Sikkim. This appears to be the first record of this lovely nuthatch east of Sikkim. The birds formed part of a small party of four or five in a tall tree.

DICAEIDAE

Dicaeum ignipectus ignipectus (Blyth): Fire-breasted Flowerpecker.

A female taken at Dening has a wing measurement 48. 5. The species was noted also at Dreyi.

Dicaeum concolor olivaceum Walden: Plain-coloured Flowerpecker.

A female taken at Tezu has a wing measurement of 44. 5.

NECTARINIIDAE

Aethopyga nipalensis koelzi Ripley: Koelz's Yellow-backed Sunbird.

Six males and two females were collected at Dreyi. They measure: wing ♂ 54. 5-55. 5, ♀ 50, 50.5; tail ♂ 58-63. 5, ♀ 41, 46; culmen ♂ 22-23, ♀ 21. Soft parts: iris brown; bill and legs black, sacs yellowish-white.

These birds were active in wild banana and plaintain clumps in open scrub. Once or twice they were seen associated with mixed babbler flocks.

Aethopyga saturata saturata (Hodgson): Black-breasted Sunbird.

A male and two females were collected at Dening and the species was seen at Sadiya. These specimens measure: wing ♂ 53, ♀ 47, 49: tail ♂ 63, ♀ 31, 5, 35. 5; culmen ♂ 25, ♀ 19. 5, 20. The male shows head moult in December.

ZOSTEROPIDAE

Zosterops palpebrosa palpebrosa (Temminck & Schlegel): Indian White-eye.

A female collected at Sadiya measures: wing 52, culm. 12.5. It is quite greenish on the upper parts. The species was also seen at Dening. Flocks frequently in association with *Stachyris chrysea* and other small babblers in canopy foliage.

MELIPHAGIDAE

Arachnothera magna magna (Hodgson): Indian Streaked Spider-Hunter.

Specimens were taken at Sadiya and Dening and the species was noted at Tezu. These birds measure: wing ♂ 88-93.5, ♀ 79.5, 84; culmen ♂ 40-45, ♀ 38.5, 39. Soft parts: iris iris brown; bill black; horny-brown, orange along lower tomium, legs yellowish-orange, chrome-yellow.

This large Spider-hunter was collected in thick forest often quite high up and often associated in mixed feeding flocks of babblers, warblers, and other small birds. Inseparable from wild banana plants, and evidently an important cross-pollinator of their blossoms. Utters a sharp *Kikikik* reminiscent of the Striped Squirrel.

FRINGILLIDAE

Carpodacus erythrinus: Rosefinch.

A solo bird was noted at Tezu.

Passer montanus hepaticus Ripley: Mishmi Tree-Sparrow.

Birds were collected at Tezu and the species was also noted at Dening in the eaves of the rest house. The male specimens measure: wing 68-71; tail 50-54; culmen 11·5-12. This is a very dark race with a purplish-brown, almost liver-colored head and considerable brownish wash on the underparts.

Though freely occupying the thatch of outhouses, and space between ceiling and corrugated iron roofs of bungalows, it does not seem to enter tenanted rooms like the House Sparrow. Has the typical sparrow chirp, but pleasanter and more musical.

Emberiza pusilla Pallas ; Little Bunting.

A pair of these pleasant little Buntings (which in America would be called "Sparrows") was taken in an open upland meadow at Dreyi.

Emberiza aureola : Yellow-breasted Bunting.

Noted at Sadiya, about standing paddy crops.

PLOCEIDAE

Ploceus sp. ?

Large flocks—literally thousands—in company with *Lonchura f. rubronigra*, seen at Sadiya on ripening paddy crops in forest clearing girt by sea of tall grass. Excessively wary and impossible to approach within shotgun range.

Lonchura ferruginosa rubronigra (Hodgson) : Northern Chestnut-bellied Munia.

A male with a wing measurement of 55, in body moult was taken at Sadiya in late November.

STURNIDAE

Saroglossa spiloptera : Spotted-Winged Stare.

Seen at Deopani near Sadiya.

Sturnus malabaricus malabaricus (Gmelin) : Grey-headed Myna.

Birds were taken at Tezu and the species was seen at Sadiya. A pair from Tezu measure: wing ♂ 103, culmen 21; ♀ W 105, culmen 20.5. Iris pale gray.

Northern Assam specimens tend to be darker above and below than birds from farther south and west.

One pair observed at Tezu had heads as white as in *blythii* of S-W India.

Sturnus contra contra Linnaeus : Indian Pied Myna.

Taken at Sadiya and Tezu. Lakhimpur and Mishmi birds have a tendency to reduced pale streaklets on the hind neck, and a somewhat darker tone below. 2♂♂ measure wing 118-124, culmen 32-35 mm.

Along with *Pycnonotus cafer* and *Pycnonotus jocosus*, perhaps the commonest and most abundant bird species in the Sadiya neighbourhood.

Acridotheres tristis tristis (Linnaeus): Common Myna.

Taken at Sadiya in November, some specimens being well-grown juveniles. These North Assam birds are slightly darker in tone of coloration than birds from southern Assam and India.

Acridotheres (cristatellus) fuscus (Wagler) : Northern Jungle-Myna.

4 males of these Jungle Mynahs taken at Sadiya and Tezu have wing measurements of 120-128. In tone of upper parts these birds appear slaty and are slightly more saturated above and below than South and West Indian examples which have the upper parts distinctly brown in tint. Iris yellow.

Gracula religiosa: Grackle or Hill-Myna.

Uncommon about Tezu, but increases in abundance above ca. 1,000 ft. elevation towards Dening.

Above Dening, on the Dreyi road, one day an enormous flock of these mynahs numbering in the hundreds took wing all at the same time and came down from a group of high trees far above the trail. They flew with fixed wings over the trail and the nearby clearings and descended into the jungle-filled gorge below. The noise of their wings was astonishingly loud, a great swishing roar. A Black Eagle which had been soaring slowly far out over the valley at a great height was attracted instantly, presumably by the sight of the

flock and circled in from a quarter of a mile's distance to the vicinity of the trail almost as quickly as the flock made their descent. However, the birds were safely ensconced in the trees below before the eagle could get within striking range.

Dicruridae

Dicrurus leucophaeus hopwoodi Stuart Baker : Assam Grey Drongo.

A male taken at Dening has a wing measurement of 150.5. The iris is brownish-red. I am indebted to Dr. Vaurie for helping me identify these drongos (R).

Dicrurus aenea aenea Vieillot : Northern Bronzed Drongo.

The Bronzed Drongo was taken at Sadiya, Tezu, Dening and on the Dreyi trail at 4,000 ft. These birds measure: wing ♂ 126.5, ♀ 120-125, 5.

Dicrurus remifer tectirostris (Hodgson) : Indian Lesser Racket-tailed Drongo

The Lesser Racket-tailed Drongo was collected at Sadiya, Tezu and Dening. These specimens measure : wing ♂ 133.5, ♀ 126-137.5 ; culmen ♂ 26, ♀ 24-26.

Has large repertoire of loud metallic musical calls like *Dissemurus*. Is also a very good mimic.

Dicrurus hottentotus crishna (Gould) : Hair-crested Drongo.

A female was collected at Tezu. It is not fully adult and has a wing measurement of 157·5. Noted at Sadiya.

Dissemurus paradiseus grandis (Gould) : Assam Large Racket-tailed Drongo.

At Tezu and Dening these birds were observed and collected, usually in the very top of silk-cotton trees (*Bombax*), which were in flower in early January. They measure : wing ♂ 169, 181, ♀ 161·5-181 ; bill from nostril ♂ 27, 28, ♀ 28 ; (culmen, 3 ♀♀ 41-42 mm.)

Irenidae

Irena puella sikkimensis Whistler & Kinnear : Sikkim Fairy Bluebird.

A male was collected at Tezu. It measures : wing 133, tail 95, culmen 29·5. Iris claret.

Call : a sharp *peepit*.

Oriolidae

Oriolus xanthornus xanthornus (Linnaeus) : Indian Black-headed Oriole.

Two first year male orioles were taken at Sadiya in November.

Oriolus traillii (Vigors) : Maroon Orioie.

Specimens including first year birds were collected at Tezu and Dening where the species was quite common. Iris in adults old ivory ; in immature brown.

Seen from below, against the sky, when flying into a lofty treetop, the bird looks black with almost crimson tail.

Corvidae

Corvus macrorhynchus tibetosinensis Kleinschmidt & Weigold : Tibetan Jungle Crow.

The Jungle Crow was seen and collected from Sadiya up to Dening. A male and three females measure : wing ♂ 342, ♀ 297, 322, 345 ; tail ♂ 210, ♀ 186, 210 ; culmen ♂ 71, ♀ 63, 65, 67. This species was not abundant, and when seen was near clearings and habitation. They are apparently scavengers. The voice, as in Jungle Crows of Mussooree and other Himalayan stations, is hoarse and raven-like.

Meinertzhagen (Novit. Zool. xxxiii, 1926, p. 83.) synonymizes *tibetosinensis* as it is based on two specimens only. These two specimens were very large (wing ♂ 375 ♀ 348, tail ♂ 260, ♀ 240.), but no culmen measurements are given. Although these Assam specimens are not as large as the measurements of *tibetosinensis* given above, and although they come within the range of *intermedius*, the Himalayan form which ranges from Afghanistan to Bhutan, their large raven-like bills are totally unlike the latter form. Mayr (Ibis, 1940, p. 694.), has shown that similar large birds occur in northern Burma. On comparison I find that the Mishmi and North Burma birds evidently represent the same population of big, large-billed birds, and consequently I would place them together in this race pending direct examination of the type and other specimens of *tibetosinensis* from S. E. Tibet.

[The House Crow (*Corvus splendens*) was absent at Sadiya and beyond in the Lohit Valley.]

Kitta chinensis chinensis (Boddaert) : Green Magpie or Hunting Crow.

The Hunting Crow was seen at Tezu and collected near Dening in thick bamboos. One specimen was pounced upon by a hawk and carried away before one author's eyes. The species is not easy to observe, as it prefers thick tangles of vines and secondary growth. Its rich melodious calls usually announce its presence.

Crypsirina formosae himalayensis (Blyth) : Himalayan Tree-Pie.

Specimens of this magpie taken at Dening seem slightly darker on the back than usual *himalayensis*. Two females have wing measurements of 141, 142.

ASTANMARG

BY

LIEUT.-COLONEL R. S. P. BATES, M.B.O.U., I.A. (Retd.)

(*With 4 plates*)

Astanmarg, the Pasture of the Shrine, is the head of a miniature vale beneath the south-eastern buttresses of Mt. Kolahoi. As Himalayan valleys go, it is but a mere pin point, the marg, even on the one inch survey map, hardly large enough to contain its name. Monstrous cliffs, clean cut as with a knife, rise almost sheer from its northern rim, while on all sides it is dominated by screes and precipitous slopes. Only to the west is there a passable outlet up a curving snow slope on which in the past many ill-clad pilgrims lost their lives before the Kashmir durbar forbade the use of this treacherous short-cut from the holy cave of Amarnath.

To approach the marg it is necessary to circumvent a narrow gorge which leaves the East Lidar's valley at Tanin. The pleasantest track mounts through fragrant pinewoods and glades behind the camping ground; glades where Orange Bullfinches drop to the short-clipped grass to feed quietly on ripening seeds before returning with soft call notes to the shelter of the young firs; woods in whose shade the trim yellow violets group themselves in neat array. Some might argue that the Yellow Violet, *Viola biflora* Linn., is too tidy a flower to be really beautiful. In comparison with other blue or lilac members of the genus this may be so, but wherever I have met with them, their orderly appearance has appealed to my military mind, their very similarity of form being reminiscent of soldiers grouped here and there on the parade-ground ready to fall-in for guard-mounting. Though not uncommon in the Kashmir forests, penetrating upwards even into the juniper tracts, they are seldom if ever to be met with below 8,000 ft. They appear, however, to be equally distributed both in the Pir Panjal mountains and on the main Himalayan Range, for we have encountered them on the former at localities as wide apart as Killenmarg, the Marbal Glen, and on the Margan Pass, and they are reputed to be common in the Gulmarg woods.

Beyond the pines lies the bare Astanmarg Valley, a forbidding debris-filled cleft some three or four miles long, a defile almost void of trees and rising to its head over successive snowbeds which give no inkling of the presence of the lovely meadow beyond them. The reason for this is simple. The marg lies round an abrupt bend beyond successive terraces of glacial origin which culminate in a stupendous ancient moraine where torn birches have grown and died in grotesque attitudes amongst the tumbled boulders. Yawning cavities, large enough to hold houses, gape between these rocks, each depression in itself a hidden bowl of flowers and the playground of Rubythroats and Redstarts. Beyond the moraine lies a verdant amphitheatre whose one-time lake has burst its way out

to dwindle to a mere pond on whose gentian-starred surround are seen the grazing buffaloes of a gujar's herd, the summer and only occupants of this superb meadow.

Unfortunately my wife and I arrived in this haven of peace in a flurry of sleet, both with vile headaches and feeling slightly sick, due undoubtedly to a too rapid ascent from the Vale. Even a touch of mountain sickness has a depressing effect and we found ourselves contemplating a retreat to Tanin and warmer altitudes. Thanks to a return of the sun and an enforced rest while we awaited the arrival of tents and gear, the nausea passed and our spirits once more returned to normal. It would indeed have been a tragedy to have succumbed to so temporary an indisposition. This lapse did, however, cause us to stop short as it were and place our camp, before the treasures of the hidden marg had revealed themselves, in the small depression where we had rested. This was on the second terrace, a spot where an iris-studded bank afforded protection from the blast which often bore down from the snow-field to the west. When the sun was up it was a delightful site, Trollius and a somewhat similar *Adonis chrysocyathus* stippling the ground with their golden tufts all about us. This Himalayan Trollius, *Trollius acaulis* Lindl., cannot compete with our English globe-flower, for the sepals lie almost flat and so lack that cosy beauty of the curled-up butter-pat blooms. The shaggy compact foliage of rich green is, however, truly beautiful.

I had come to Astanmarg with a view to tracking down certain Rosefinches reputed to nest there, but the first week of July proved too early. There were other birds to interest me of course, while the flowers were sufficient to make any keen alpine gardener gasp for breath. Hordes of Mountain-Finches, *Fringilauda nemoricola altaica* (Eversm.), were about to nest. These ground-nesters still cling to their colonial habits even in summer, yet their nests are indeed hard to come by, for they may be two or more feet within passages and cavities under large stones, the tortuous excavations of voles undoubtedly supplying many pairs with their wants. As might be expected of the contents of nests which never see the light of day, the eggs are plain white, which somehow seems wrong for a self-respecting finch, the members of whose family in general lay such colourful and handsomely patterned eggs.

A bird whose presence at once caught my attention was the wild Central Asian Blackbird, *Turdus merula maximus* Seebohm. Reports of its breeding in Kashmir are sketchy in the extreme, relating only to family parties already beyond the nest stage, so in ten days to run to earth no less than three pairs I felt to be no mean achievement. In point of fact this fine race of our typical blackbird is by no means uncommon in the Western Himalayas, but it is a bird of high altitudes nesting up to the permanent snowline and in summer never descending below 11,000 ft. Its high habitat in a virtually treeless zone has imposed upon it very much the ways of the Ring Ouzel. It is not in reality unduly shy, but since the open nature of its ground seldom affords a covered approach, the bird usually takes to its heels some distance away, flying low between the boulders soon to curve out of sight down some concealing gully or behind a patch of juniper. Harsh cackles frequently proclaim its disgust on being disturbed

but at other times it is rather a silent bird, the song being poor and infrequently indulged in. Though more often than not to be seen perched upon nothing higher than a rock, one of my males had selected as its singing-post the summit of a gaunt birch about 50 yards from its nest. This particular nest was amongst the buttress roots of another gnarled birch growing from the side of a steep bank. The other two, however, were close up against large boulders on nearly level ground, one of them barely concealed by a couple of podophyllum plants, *Podophyllum Emodi* Wall., whose large scarlet berry produces a drug much used in the medical profession, though not, I believe, employed by the Kashmiri in that connection: rather strange since few of the many useful Himalayan plants appear to have escaped the attention of the Kashmir 'hakims'. To quote, in fact, from Lawrence's *Valley of Kashmir,* 'The native physicians attribute some property to every plant, and when I have made inquiries as to the various herbs which I have seen in the Valley and on the hillsides, I am always told that they are hot and good for cold humours, cold and good for hot humours, dry and beneficial to damp humours, damp and beneficial to dry humours.' The list of indigenous medicinal plants employable in the treatment of both man and beast is indeed of such great length that, if multiplicity of available medicaments counts for anything, the hakims are indeed favoured members of the brotherhood of healers. Have they not specifics which cure anything from saddle sores to sword wounds, snake bites and scurvy, and most internal complaints into the bargain. In point of fact they are extremely ignorant and their violent methods of alternate purges and starvation often turn minor ailments into fatalities. But to hark back to the blackbirds. Two of my nests contained naked young, three in the case of the nest by the podophyllum plant, while on the date of discovery, July 1st, the nest in the birch roots held three fresh eggs. This nest was indistinguishable from that of a European Blackbird; the other two were much bigger. The eggs, in addition to being considerably larger, were rather more boldly marked, one being reminiscent of a Mistle Thrush's egg with its bold blotches.

Our camping ground boasted of one isolated tree, about 20 feet high, in the upper branches of which was a conspicuous stick nest. Its interior of finer material was neat and tidy but showed no signs of occupation. It may have belonged to a Buzzard, but I have reason to believe that the owner was in all probability a Booted Eagle, *Hieraëtus pennatus* (Gmelin), which visited the tree twice during our stay. In spite of the few published records of nests within Indian limits, this small eagle is not uncommon in Kashmir; in fact, Mr. Osmaston goes so far as to exonerate in part the Black-eared Kites of the Vale from the charges of chicken-stealing levelled against them in favour of this other marauder.

Pipits were of course our near neighbours. Before long I noticed a highly-marked individual collecting dry grass amongst the iris and Trollius tufts around us. The heavy streaking of the entire breast marked it out from Hodgson's Pipit, *Anthus roseatus* Hodgs., the bird depicted here, which has the centre of the vinous breast immaculate, besides being the darkest of the family. Our nest-maker was a Witherby's Tree-Pipit, *Anthus trivialis haringtoni*

Photo by R. S. P. Bates

A male Blue-fronted Redstart about to feed a young Asiatic Cuckoo.

Photo by R. S. P. Bates

A Hume's Willow-Warbler, well above its normal altitude, had built amongst the juniper roots.

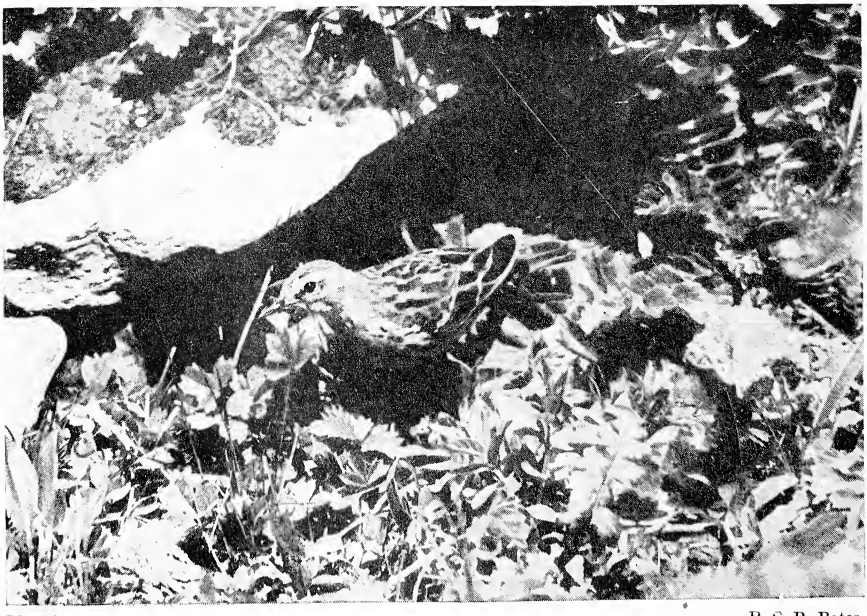

Photo by R. S. P. Bates

A Hodgson's Pipit leaving its nest.

Witherby, but unfortunately I failed to trace its building site which was somewhere in the rather marshy open ground below the terraces at the foot of the snow slope.

It was down there that we first became acquainted with the most beautiful of the many kinds of Corydalis to be found in various parts of our domain. These included the extraordinary *Corydalis crassifolia* Royle, with its whorl of overlapping, almost fleshy leaves contrived to withstand the movements of the shifting stones of an unstable habitat on steep screes. Its flowers too are rather coarse and overcrowded though remarkable in being amethyst-purple in colour. Our dainty Corydalis of the flats was *Corydalis cashmeriana* Royle, whose delicate long-spurred flowers are a lovely cobalt blue with dark blue tips.

The morning after our arrival I made for the shattered moraine, as I soon dubbed it. It was on my way that I observed the Hodgson's Pipit tripping purposefully from the direction of a cavity under a stone in the bank of a little dry water-course. Further on, within a circle of birches just short of the moraine, I espied a warbler on its way to a nest in the roots of a small patch of juniper. To my surprise its underparts were pale in comparison with the deep yellow underparts of Tickell's Willow-Warbler, the only member of this group usually found at such high altitudes. Besides, it possessed a coronal streak and wing-bars in addition to the supercilia, so proclaiming it to be Hume's Willow-Warbler, *Phylloscopus inornatus humei* (Brooks). The nest readily confirmed this diagnosis, for the eggs were well-spotted with red-brown. It was also sunk deep into the juniper's roots, whereas the untidy grass dome of Tickell's Willow-Warbler, *Phylloscopus affinis* (Tickell), which is always snugly lined with feathers, is built off the ground, frequently rather conspicuously placed two feet or so up on the outer rim of its bush. The eggs in the case of this bird are but sparingly marked with minute freckles and frequently but one egg of a clutch shows any markings at all. Hume's Willow-Warbler is happier at much lower levels, preferring sunny glades in mixed forests where it occurs in large numbers between 7,000 ft. and 10,000 ft., being in fact the next commonest of the Phylloscopi to the Large Crowned Willow-Warbler. As I had the hiding-tent with me, we straightway erected it and retired to one of the hollows to give the bird time to get used to it.

Lying in the sun on the warm short turf, I lazily remarked to my wife that we seemed to be causing a female Rubythroat, *Calliope pectoralis pectoralis* Gould, considerable anxiety, for she kept appearing on the boulders first to one side of us, then to the other. Suddenly I caught sight of her not a yard from my right elbow. Unfortunately I sat up the better to look around and in so doing put my hand on a small weed. The damage was done! A little dome of grass flattened under the pressure and two faintly marked blue-green eggs spread their sticky yolks about my palm. Never have I seen a nest of this bird in quite so open and unprotected a spot. Generally the base of the nest is well let into a tuft of rank herbage or roots of a bush, most frequently well back from the outer edge of a juniper patch. The dome completes about three-quarters of the

sphere, the opening being little if any above the general level of the half-buried roots. Undomed nests have also been reported, but such open cup-shaped affairs have never fallen to my lot and I cannot help feeling that these reports have for some reason or other been inaccurate.

The Willow-Warbler proved so amenable that an hour in the hide sufficed for the exposing of all the plates I felt I could then spare. The rest of the afternoon was devoted to exploring the moraine and to taking colour and monochrome photographs of its amazing flora. The grass-covered surface of one immense sloping boulder was entirely obscured by a tangle of the pale green thistle-like leaves of the yellow-flowered Morina, *Morina Coulteriana* Royle, its subtle perfume pervading the air for many yards around it. Another rock was patchily quilted with Androsace of two distinctive kinds; the taller, *A. sarmentosa* Wall, with conspicuous cushions from which sprang four to five inch stems crowned with clusters of pale rose flowers; the other, the short stemmed *A. microphylla* Hook. F., whose closely-packed stiff little rosettes gave it at a distance the appearance of a saxifrage, this illusion being enhanced by the short scapes varying from but a quarter to an inch in length. The flowers in this variety range from white to pink or rose.

To complete a really happy day we gathered armfuls of pale blue Columbines, to which on our way back to camp were added numbers of the dark purple solitary-flowered *Aquilegia jucunda* Fisch. & Mey., which were growing at Astanmarg in greater profusion than we had seen them elsewhere.

The following morning I reverted to birds'-nesting, returning to the marsh where I had once seen Yellow-headed Wagtails. This year they were entirely lacking. In fact, the only wagtails seen were two pairs of Grey Wagtails, *Motacilla cinerea caspica* (S.G.Gmelin), one of which owned a nest of two eggs tucked into a Trollius plant. The clutch was incomplete and, though I waited a couple of days before attempting photography, neither of the birds would come before the lens. The absence of Hodgson's Yellow-headed Wagtail, *Motacilla citreola calcarata* Hodgson, was a disappointment as I have never photographed this interesting species at the nest. At times very large numbers breed in the Vale, particularly on those marshes which are surrounded by wide expanses of soft grass and thin reeds, many placing their nests in real swampy patches so that the bases of the compact grass cups are quite wet. As far as I can judge this bird's numbers fluctuate year by year to an extraordinary extent, it being occasionally difficult to trace any at all at Valley level. They have, however, a wide distribution, breeding throughout the Western Himalayas up to 14,000 ft. and on well into Central Asia, so that any of the mountain tarns providing the necessary marshy conditions are apt to produce their quota. On the southern face of the watershed of the Great Himalayan Range I have seen them in the wide amphitheatre near the Yamhar Pass, near Sonamarg, at the source of the Lidar Valley by Kolahoi, in the Wardwan Valley, and elsewhere at the higher altitudes. The nest has also been taken at Lake Gangabal near the glaciers of Haramoukh. Both sexes of this exceptionally hand-

some wagtail breed in large numbers in immature plumage, a pale washed-out version of their full-dress, though the females never at any time aspire to the same brilliance as their mates whose lemon-yellow heads and breasts contrast so strikingly with their deep black backs and dark wings.

Wagtails being non-co-operative, I turned my attention to the Redstarts, the rather unfortunately named Kashmir Redstart, *Phoenicurus ochruros phoenicuroides* (Hodgson & Moore), and its Blue-fronted namesake. The great majority of the former species, which winters in large numbers in the plains of North India, pass on migration far beyond the Great Himalayan Range though round about 11,000 ft. a modicum do pause to nest. The Blue-fronted Redstart, *Phoenicurus frontalis* Vigors, is far the more numerous of the two throughout Kashmir proper, and is found breeding quite commonly in the Pir Panjal Mountains as well as throughout the main range.

Two pairs of Kashmir Redstarts were undoubtedly nesting on a rocky slope not far from our tents but their extreme caution defeated us. For a time it appeared that but for the Central Asian Blackbirds my visit to Astanmarg was going to add little new to my picture gallery. Luckily, returning through the shattered moraine, I espied a Blue-fronted Redstart with a grub in its bill. Its interest appeared to be centred around a battered tree-stump about four feet high. This species usually selects a hole in the ground or in a wall but here was a nest in the top of this stump, its sole protection from above being a piece of rotting wood which formed within the shell a kind of lean-to. The nest itself was of little interest, a mere collection of bents and dried grass lined with a few white roots, but its contents at once aroused my enthusiasm. Entirely filling the cavity, in fact swamping the whole nest, was a greedy young cuckoo, a young Asiatic Cuckoo, *Cuculus canorus telephonus* Heine. Back to camp we went for the hide and by dusk the tent was erected for use on the morrow, complete down to its well-camouflaged dummy lens.

Around 12,000 ft. seems a high altitude for this villain amongst birds to further its nefarious plots, but there were indeed two species of cuckoo at Astanmarg, the Small Cuckoo, *Cuculus poliocephalus poliocephalus* Latham, adding its cacophony of discordant noises to the avian chorus, and that by night as well as by day. How strange it is that these two cuckoos so alike in plumage—I must add a third, the Himalayan Cuckoo, *Cuculus optatus* Gould—should have such widely divergent voices and habits. The Small and Himalayan Cuckoos are forest-loving birds, though the former occupies more open ground than the Himalayan species which is to be found in even the most dense pine woods and always in forest of some sort. Astanmarg was consequently not to its liking, its limits ending with the blue pines a couple of miles down the valley. The Asiatic and Himalayan Cuckoos are as like as two peas in the field, that is until they open their mouths, for the latter has the sonorous voice of a hoopoe, except that it generally indulges in a four-fold repetition of the hoopoe's 'hud-hud.' Of course, all these cuckoos produce many other 'noises-off'. Once in the gloom of a seem-

ingly untenated pine wood, I was thoroughly startled by the most ghoulish groans, grunts and cackles, only to find that my discomfiture was caused by a Himalayan Cuckoo some twenty feet above my head.

The egg of the Small Cuckoo appears seldom to have been taken in the Kashmir Himalayas, though why I cannot really imagine. The bird is numerous; its usual fosterers are well known, and so are the two dissimilar types of eggs which it lays at the extremes of its range. In Japan it victimizes warblers of the genus *Cettia* almost exclusively, laying, to ensure their co-operation, a terracotta-red egg like their own. As we move westwards a white egg also appears so that in the Eastern Himalayas, and as far west as Garhwal, eggs of both types are found in nests of Bush and Willow-Warblers, and occasionally in nests of other birds as well. In the Western Himalayas probably the white egg alone is deposited. As it averages very slightly *larger* than that of the Himalayan Cuckoo whose eggs are not infrequently plain white, or so minutely and sparingly spotted as to be virtually so, this may provide a clue to the problem, since both birds are likely to aim at the same fosterer in preference to all others, namely the Large Crowned Willow-Warbler. When we consider that the Small Cuckoo is only two-thirds the size of the Himalayan Cuckoo, the fact that it lays an egg of almost identical size may easily result in confusion. The Pale Bush-Warbler, with its 'deep chestnut-chocolate eggs'—to quote from the *Fauna*, though the first one I saw I immediately likened to the colour of Cadbury's Mexican chocolate—, is exceedingly common in Kashmir between 6,000 and 8,000 ft. and might confidently be expected to attract the deposition of the red egg of *poliocephalus*. Yet no one, not even that keen observer Mr. B. B. Osmaston who has investigated many Bush-Warblers' nests, has ever chanced upon the combination. But let us leave this mystery, which I hope will not defy solution much longer, and hark back to the redstarts.

Once left to myself in the hide, I had less than quarter of an hour in which to redistribute plate-holders, note-book, and other odds and ends, not to mention limbs which somehow always seem to be in the wrong places in spite of the most careful planning before the dismissal of one's helper. The female it was who first called me to action, though the male was not far behind her in his efforts to cope with the voracity of the young cuckoo. But just as we were all settling down to high speed action, a mystifying lull occurred. The plaintive danger-call was set up, soon to become a continuous dirge. From peep-holes I espied the agitated redstarts hovering around the area, first on one perch and then on another, but never approaching within less than 15 yards of that Brobdingnagian youngster. The monster must by now have been enduring the pangs of hunger, for no longer was he being fed every few moments. Whatever was the matter? I realised suddenly that 40 minutes had passed by since I had last released the shutter, so decided to call up my helper. As I was on the point of pushing out a corner of a handkerchief from the back of the hide in the prearranged manner, the whole problem was suddenly

Photo by R. S. P. Bates

Cortusa matthioli, a striking cerise flower burdened with a particularly ugly English name, Bear's-ear Sanicle.

Photo by R. S. P. Bates

Androsace of two kinds grew cheek by jowl on the same rock, the tall *A. sarmentosa*, shown here, and the small-leaved *A. microphylla*.

resolved. One hundred yards away on the topmost twig of a dead tree I espied the motionless shape of a cuckoo, engaged no doubt in a silent survey of the occupants useful to it in its territory. Could anything have been more ludicrous! Here was a pair of redstarts at pains to conceal their nest from this hated parasite, when they were already harbouring one of its youngsters and fostering it with the greatest zeal. Khalik Khan shooed her off to pastures new and the old routine of rapid visits was started afresh.

It took both birds all their time to keep that young cuckoo supplied, though the male in his head-dress and coat of deep dull blue which he wore over chestnut pants and chestnut tail with its distinctive black tip to make identification easy, put in but half as many journeys as his more conscientious wife. And she it was who attended more strictly to nest sanitation, after almost every feed hopping along the young giant's back, whereupon without further stimulation it automatically evacuated the faecal sack to be seized at once and removed to a distance by the waiting parent.

As baggage ponies to take our gear down to Pahlgam had been arranged for the following day, we decided to spend the last afternoon amongst the flowers. We had intended to probe the marg's furthermost acres, but to our surprise and annoyance the lassitude and shortness of breath of the first day had never worn off; in fact, rather had it increased. Our constitutions had definitely rebelled at the too sudden rise in altitude. Perhaps all would have been well had we spent even two nights at Tanin instead of one. Nevertheless, the fact remains that that afternoon by the time we had crossed the shattered moraine further progress held no attractions for us. Happily there was more than enough in the immediate vicinity to fill our remaining hours. Once again a huge boulder and the banks around it constituted a flower garden which no human hands could ever have laid out more pleasingly. A patch of smoky blue, protruding from a crevice at shoulder height, warranted immediate investigation. Yes, it really was Eritrichium. I have never seen *Eritrichium nanum* in its own setting, in its way perhaps the most beautiful of all rock plants, that plant which Reginald Farrar has described in such vivid prose in *My Rock Garden*. One can picture the beauty of that scene: the quite unimaginable blue massed on the sunlit slope. Perhaps *Eritrichium strictum* Dcne., our Astanmarg variety, never does appear in overpowering masses: I do not know, being no real botanist. Indeed, I must confess that before my wife took me in hand, I was evidently blind to the beauties of individual wild flowers. When discussing plans for our first combined visit to Kashmir, I had had to admit that I could not name a single flower I had noted in the alpine meadows, although I had of course brought away an impression of vivid colouring. An observer trained along one line can apparently miss all else, for when at length we crossed the Yamhar Pass on the same date in early July as I had done some years previously, I found that in places it was an impossibility to avoid trampling on flowers, so prolific were they: Asters and Inulas as big as saucers, sheets of blue Mertensia, and near the summit pads of the lovely purple Creep-

ing Primrose. On the very crest were the drooping yellow heads of *Cremanthodium Decaisne* Clarke. Now, thanks to my wife's enthusiasm for all that is colourful and beautiful in the mountains, my eye catches the gleam of an unexpected bloom nearly as quickly as it picks out the movements of a bird. But were we not discussing Eritrichium?

Here at Astanmarg and at Sona Sar I have seen Eritrichium flowing in occasional tufts from the cracks of massive rocks, sites where in bright weather it received all the evening sun, and, in rain and wind, protection of its rootstock from the jutting rock above it. The smoky forget-me-not blue against the grey lichen-spotted stone was so lovely that I used a colour-film upon it, reserving the panchromatic plates for finds of lesser importance, an action I regret since I now possess no negatives worthy of reproduction in monochrome.

To reach the Eritrichium, I found myself amongst a welter of tall anemones. The flower-stalks were as much as two feet high and bore many-flowered umbels of large white blooms between one and two inches across. This was *Anemone tetrasepala* Royle, a large-flowered species abundant in Kashmir between 7,000 and 11,000 or 12,000 ft. After dealing with this anemone I turned my attention to a huge birch between whose spreading buttresses I espied the dainty purple flowers of *Cortusa Matthioli* Linn. The hanging funnel-shaped flowers remind one of the Bell-flowers, but Cortusa, I gather, belongs to the Primrose family. Be that as it may, it is a flower which exudes sufficient charm to turn the bases of the bare rocks or the naked earth between some drab roots into a real picture.

These are but a few of the treasures of that little paradise but space precludes a longer list. Suffice it to say that amongst others I photographed the bluest of blue Gentians of whose identity I am still uncertain. And last, but not least, under a ledge on that self-same rock ten delicate flowers quivered in the breeze looking as if every puff would blow away their frail petals of delicate bluey-white. In spite of its apparent frailty, *Paraquilegia grandiflora* Drum. & Hutch., the Large-flowered Rock-Anemone, occurs only at high elevations, from 11,000 ft. up to the snow-line. Near Baltal, when taking shelter under a shelving cliff in the wildest weather, I came across the blue-green tufts of feathery leaves drooping sodden from its broken face. The fragile flowers were hanging on their thin scapes face-downwards and bedraggled. Yet hardly had the storm passed when they raised their paper-like heads, unfolded the crumpled petals and soon looked as fairy-like and ethereal as ever. Unfortunately I still lack that perfect photograph of Paraquilegia which I so desire. I had perforce to leave the development of the plates I used on that memorable day until we had reached our new camp, and when at length I came to view the Rock-Anemone's negative I experienced bitter disappointment. More than half the plate was hopelessly fogged; how, to this day I do not know.

MARINE FISHERIES OF KODINAR IN KATHIAWAR.

BY

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(With a map, one sketch and two photographs)

(Communicated by DR. S. T. MOSES, M.A., D.SC., F.Z.S., F.R.A.I.)

INTRODUCTION

A general survey of the fishing industry in Madhwar, one of the fishery centres on the Kodinar coast, was first conducted by Dotiwala in 1916 and in his report[1] certain proposals were made for its improvement. Hornell after studying the general position of the industry in this area during his short visits in 1917 and again in 1930 recommended a programme of fishery development for the two ports of Madhwar and Kotda.[2],[3] In 1937 when a Fishery department was started in the State with Dr. Moses as its Director, more systematic surveys were possible and Moses published a check list of fishes occurring in the State waters based on collections he made from 1937-1939[4], a sizeable portion of which was from the Kodinar area. As a result of studies and investigations preliminary to the starting of the shark-liver oil scheme and during its working a check list of Elasmobranchs was published.[5] An account of the fisheries of this coast was also included by Moses in his article on 'The Fisheries of the Gujarat Coast'[6] and in the departmental bulletin[7] 'Baroda Fisheries'. These are the only existing publications on the Fisheries of Kodinar. The data collected, incidentally during investigations mostly industrial were naturally incomplete and lie scattered in the various departmental reports and notes. The author started his investigations during the fishing season of 1946 with a view to gain as complete a knowledge as possible of the local fisheries. The present paper

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[1] Bulletin No. 4. Dept. of Commerce and Industry, Baroda State (1921) Section I (1) 'Report on the Fisheries at Madhwar and proposals for improvement' by K. R. Dotiwala pp. 1-13.

[2] 'Report on the further development of the fishery resources of Baroda State' by James Hornell (1918).

[3] Bulletin No. 30. Dept. of Commerce, Industries and Labour, Baroda State (1930) 'Report on the marine fisheries of Baroda State in 1930 with suggestions for further developments' by James Hornell.

[4] Annual report of the Department of Fisheries, Baroda State, for the year 1937-38, pp. 16-20 and the year 1938-39, p. 16.

[5] Annual report of the Department of Fisheries, Baroda State, for the year 1940-41, p. 23.

[6] Journal of the Gujarat Research Society, Vol. IV, No. 2, April 1942, 'The Fisheries of the Gujarat Coast' by Dr. S. T. Moses, pp. 61-82.

[7] Bulletin No. XI of 1947 of the Department of Fisheries, Baroda State, 'Baroda Fisheries' by Dr. S. T. Moses.

mainly embodies the results of these investigations and in its preparation free use has been made of the departmental records containing the data collected by previous workers.

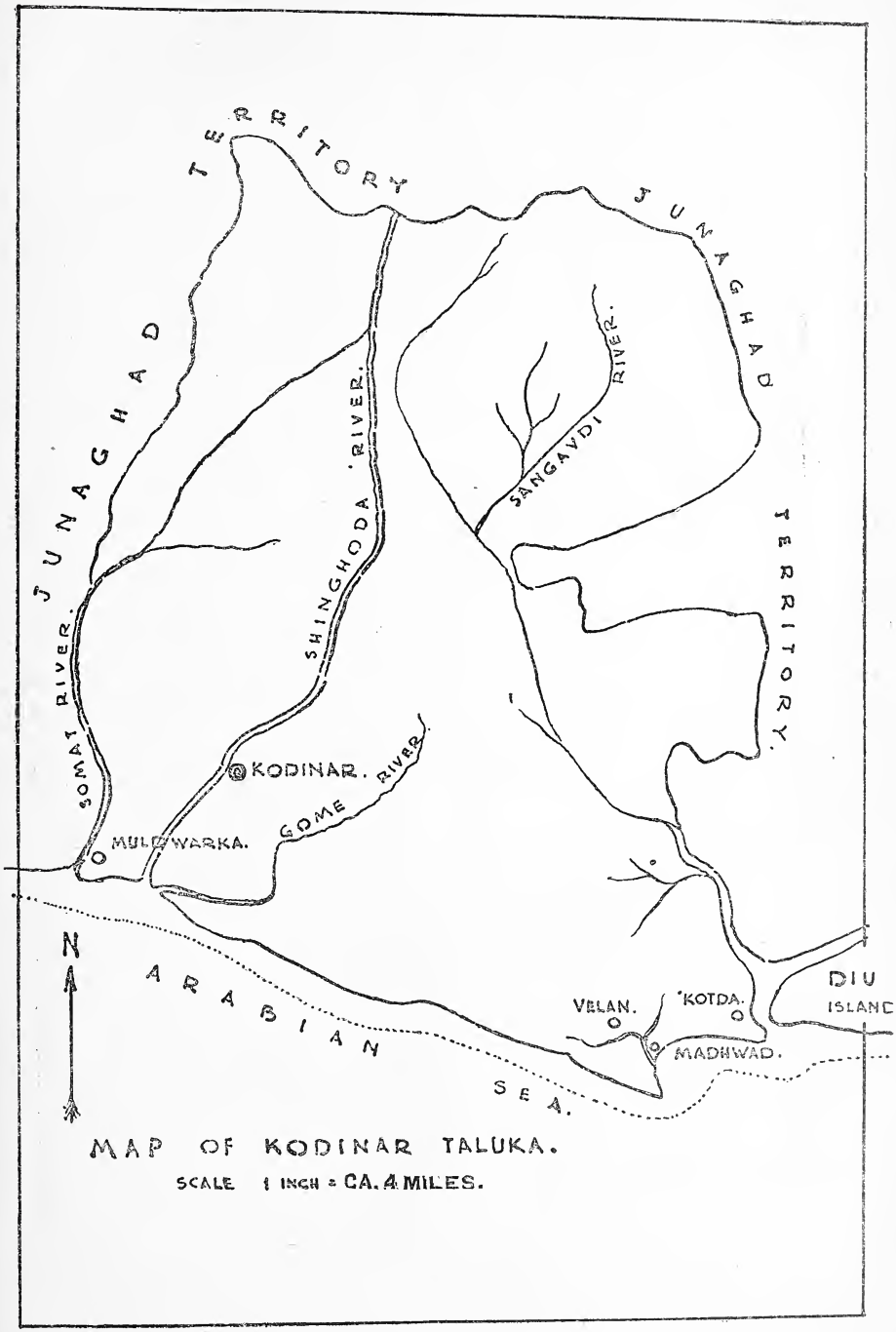
Kodinar is a detached block of Baroda territory, 207 square miles in area, situated in the southernmost end of Kathiawar in the district of Amreli. It is bounded by the Junaghad State territory on the West, North and East and the Arabian sea on the South. To the Southeast of Kodinar and separated from it only by a creek is the island of Diu (*vide* map). The land consists generally of a level plain of fertile soil and is irrigated mainly by the rivers Shingoda, Somat and Singavado.

The seas off Kodinar are characterised by regular and not too strong winds and well protected ports. The three important fishery ports of the area are Muldwaraka, Madhwad and Kotda. Muldwaraka is a safe weather port situated between the mouths of the Somat and the Shingoda about three miles from the town of Kodinar. To the east of Muldwaraka and about eleven miles southeast of Kodinar is the port of Madhwad. The nearest village Velan is two miles from the port. Consisting of a fine bay, well protected from the north and west, this port has fairly deep water close into the central beach affording harbour for vessels of 200 khandies and for larger vessels at high tide. Experts are of opinion that if a breakwater is built from the headland on the west side to a rock some distance away in the mouth of the bay, the resultant harbour will be far superior to any existing on the western coast of Kathiawar. As it is, at low tide the vessels have to lie off for more than two to three hours and this naturally results in the deterioration of the catches. However Madhwad is the most important port on this coast and during the season the major portion of fish trade is concentrated here. About three miles to the east of Madhwad is the port of Kotda. Located on the south side of a wide creek dividing the Kodinar taluka from the island of Diu, it is well sheltered and except when the tide is low there is enough water to admit fishing boats even of the larger size. Of late the accumulated silt has rendered passage of boats difficult at low tide and there is a scheme to deepen the creek and ensure that a floating basin is formed for the fishing boats to enter and leave at all states of the tide.

All these ports are served by adjacent and open expansive areas for the camping of fishermen and curing and drying of fish. The fishing grounds lying within the 10-fathom line are very rich and famous and the extensive creeks afford good fishing during the offseason. Despite all these natural advantages, the coast suffers from a serious handicap in the paucity of local fishermen, except for a few Machiaras of Kodinar who during the season camp in Muldwaraka and do fishing in the adjoining seas.

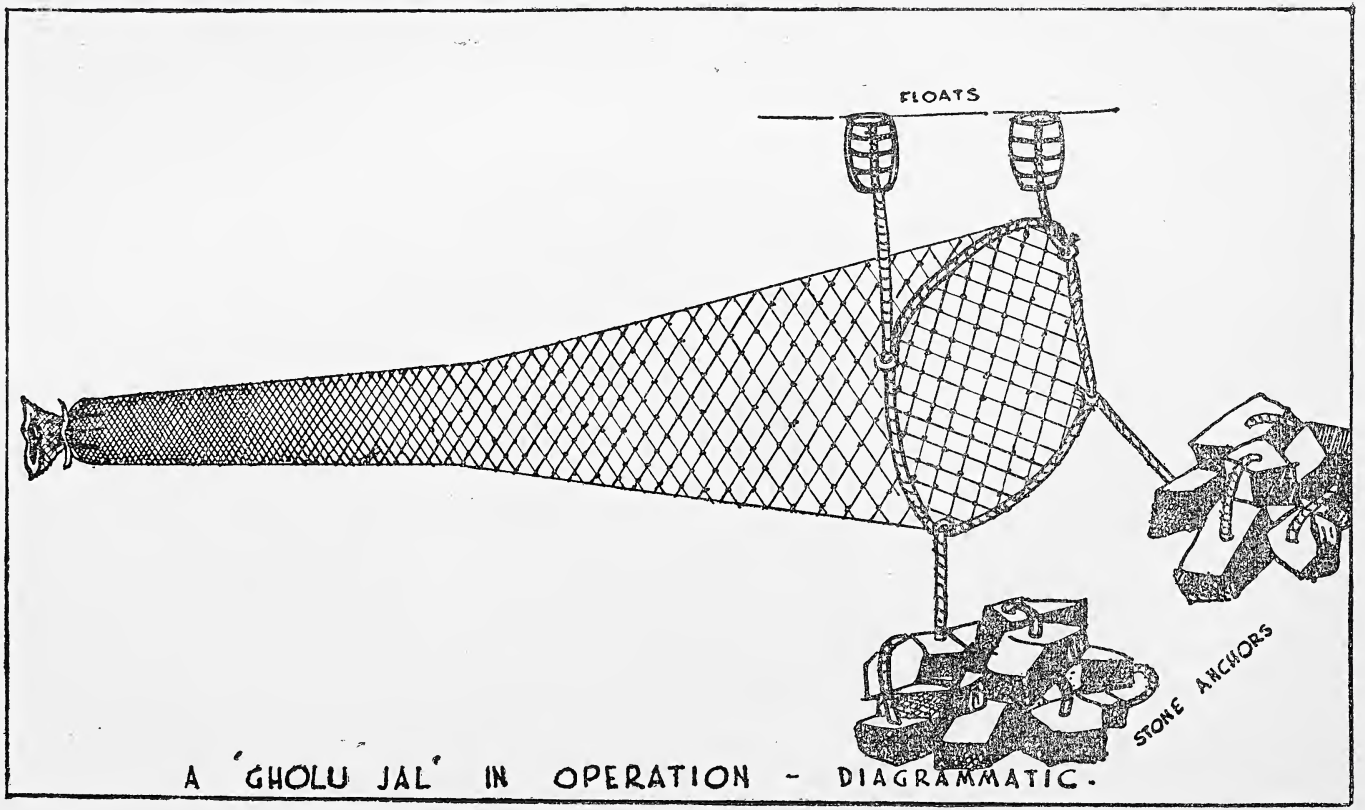
FISHERMEN

Machiaras.—The local fishermen population, as mentioned above, consists of a dozen families of Machiaras (Muslims) resident in Kodinar. During the fishing season which on the Muldwaraka coast extends from September to the end of May or the



MAP OF KODINAR TALUKA.

SCALE 1 INCH = CA. 4 MILES.



A 'GHOLU JAL' IN OPERATION - DIAGRAMMATIC.

beginning of June, they construct temporary huts in the vicinity of the port and do fishing with drift nets. The social and economic condition of these men is not very different from that of their brethren elsewhere in India. The Bombay merchants or their agents who also camp here during the season give them interest-free advances under the agreement that their catch will be sold to them at fixed rates for the season, only enough being retained for their own consumption. The merchants procure for the fishermen such requirements as yarn, hemp, bark for tanning nets etc. The Machiaras own their boats and tackle in use. During the season fishing is done regularly except on Fridays which are observed as holidays.

Machis.—The Machis are Hindus and natives of Gujarat belonging to the villages of Daman, Meyi, Dungri, Umarsadi, Kalai, Fansa, Maroli, Kolak etc. They camp in the ports of Kotda and Madhwad during the fishing season which usually lasts from October to May and do fishing with bag nets. Forty to fifty boats visit the ports annually in three to four instalments. The size of the fleet is generally dependent on the availability of good fish during the season. The Kotda camp extends from October to end of January or beginning of February and about ten to twelve boats land catches here. The Madhwad camp begins by about November and lasts till May or the beginning of June. A number of Daman Machis also camp in the Portuguese village of Vanakbara opposite Kotda and fish on the coast. Each boat has a crew of nine and fishing is done on a co-operative basis. Each man brings his net and his quota of equipment like floats etc. At a time eight men go to sea leaving one man ashore to look after the drying of nets and fish. The catches are shared equally by all the nine and the owner of the boat who maintains the vessel in perfect sailing order. The larger and valuable fishes in the catches are sold to the camping merchants according to previous contract. For the curing and drying of the cheaper and smaller varieties they engage Koli women who are paid 10% of the product as wages. The Machis observe 'Agyaras' i.e. the 11th day of the lunar month as a holiday.

Kharvas.—Unlike the Machiaras and Machis, the Kharvas who are residents of the villages of Vanakbara and Goggila in Diu island, do not camp in the Kodinar territory. They only do fishing on its coast and land the catches at one of the three ports. The Kharvas are Hindus and are expert fishermen and sailors, venturing as far out as 20 miles or more into the sea in pursuit of shoals of fish. More than 100 boats manned by Kharvas work in the grounds, sharing the catches equally. The owner of the boat who is usually one of the crew gets two shares. These fishermen receive advances from merchants and bind themselves to sell their catches to them at scheduled rates for the season. The daily earnings of these men are comparatively very high but the vice of drink is so very prevalent that their general economic condition is not at all sound. The Kharvas also, like the Machis observe 'Agyaras' as a holiday.

Trading in fish is open to all on the Kodinar coast but at present the bulk of it is in the hands of three companies of outside merchants.

Fishing Craft

Muldwaraka Hodis.—The Machiaras of Kodinar operate drift nets from 'Hodis' which are dugouts made of Malabar teak. They are 22 to 26 feet long, 3 to 4 feet broad and 2 to 2½ feet deep. The boats are strengthened by riblike projections on the inside; but in the old ones separate ribs are attached. Below the bow is fitted a keel 5 to 6 feet long and 5 to 6 inches broad. The gunwale is raised by means of a broad plank fastened to the boat using split bamboo as a sort of protection to the joint all along (Photograph 1). The stern which is a bit lower than the bow is fitted with a bent rudder adapted to the shape of the boat and fitted on by means of iron pintles and gudgeons. At the present rates a hodi costs Rs. 500 to 700. The crew comprises of 3 to 4 men and a boy. The boat is propelled by oars or when there is favourable wind on sails.

Gujarat Hodas.—They are clinker-built vessels having a burthen of 10 to 20 tons. In prewar days a hoda used to cost Rs. 1,000 to 2,000 but now the rates are treble or even more. The bow and the stern are decked leaving the central portion open for the reception of the nets and catches. The crew consists of 7 to 8 men of whom one will be the tindal or the captain. During the offseason these boats work as cargo vessels.

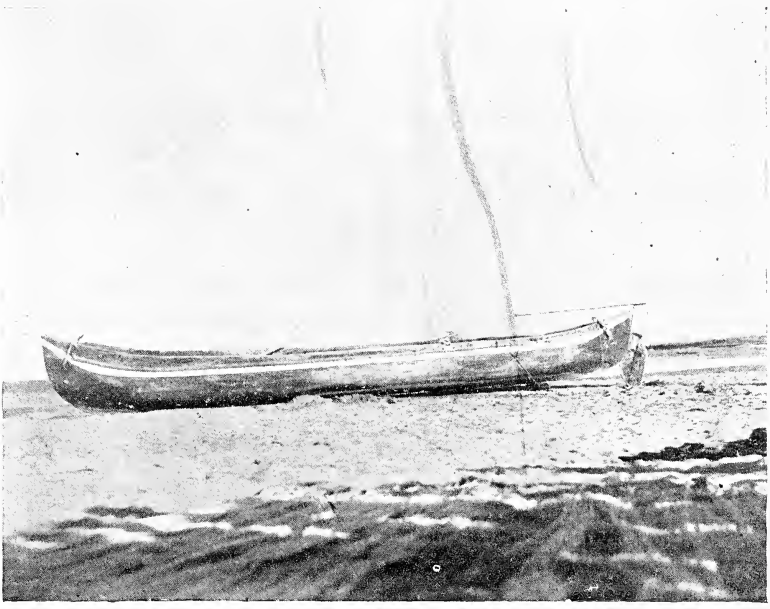
Vanakbara 'Hodis'.—These are very similar to the Gujarat hodas in construction and are of about 10 to 12 tons displacement. The crew consists of a minimum of 5 to 7 men and they carry with them a tender canoe to the fishing grounds to facilitate the operation of the nets.

All these boats are seasonally painted with 'Chopad' (formerly extracted from shark livers by allowing them to rot in tins, but now obtained from the department as refuse left after the oil is extracted) which acts as a good preservative.

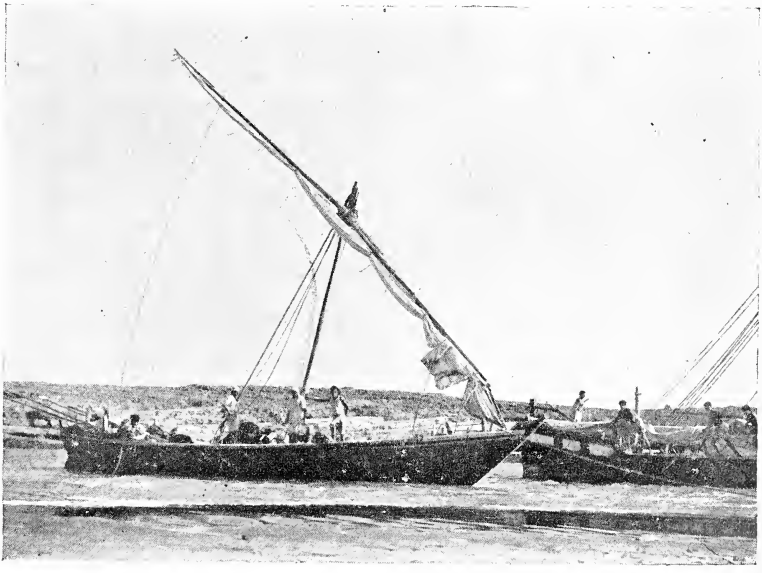
Nets and Methods of Fishing

The Machiaras and Kharvas use the same type of nets, viz. drift nets, mainly meant for the capture of Pomfrets and Hilsas and their allies. The Kharvas also employ shark nets while the Machis confine their operations to bag nets.

Vichuda Jal.—(Pomfret net) is a drift net made of twisted cotton yarn. The number of pieces in each fleet of this net differs with the capacity of the boat from which it is operated. Thus at Madhwad 40 to 50 pieces form a fleet when operated from the Vanakbara hodis but at Muldwaraka the 'hodis' being smaller only 20 pieces are shot at a time. Each piece is 60 fathoms long and 1½ fathoms deep and the mesh measures 3″ to 3½″. There is a head rope about ½″ thick, passing along the upper margin of each piece. To this is tied 6 ft. apart pieces of wooden planks cut in rectangular or square shapes. They serve as floats for the net. The lower margin is strengthened by a foot rope, a little thinner than the headrope. Small pieces of stones perforated in the centre are tied to this at distances of about 6 ft. by means of thin cotton rope. These stones form the weights to keep the net stretched and upright when operated.



Muldwarka *hodi* used by Khārvās for fishing in Kodinar coastal waters.



Vanakbara *hodi* used for hilsa and pomfret fishing by Machhiaras.

Drift-netting for pomfrets, is done during day time only, except for the black kind. On reaching the fishing grounds several pieces of netting are tied, end to end by means of the free ends of the head and foot ropes at the 4 corners. They are then slowly paid out. The Kharvas of Vanakbara use a tender-canoe to spread the net. One man takes charge of the end and rows away from the 'hodi' in the tender-canoe. The whole fleet is slowly released and the man in the canoe sets it in the form of a loose wall. When in action the length of the fleet will be only 1/3 its actual length. The floats keep the upper margin of the net on the surface and the sinkers just scrape the bottom of the sea. The net is allowed to drift with the current and shoals of pomfrets striking against it get entangled. It is usually hauled up at the turn of the tide. The season for fishing with this net on the Kodinar coast is from the end of September to beginning of May.

Palwa Jal.—(Hilsa net). This is also a cotton drift net very similar to 'Vichuda jal'. A fleet of 'palwa jal' consists of 50 pieces at Madhwad and 30 pieces at Muldwaraka. Hilsa being a bigger and stronger fish than pomfret, the net pieces are shorter. Each piece is 15 fathoms long and $1\frac{1}{2}$ to 2 fathoms deep. The meshes are also smaller and measure $2''$-$2\frac{1}{2}''$. There is a headrope about $\frac{1}{2}''$ thick and tied to it are a number of spindle shaped wooden floats. The footrope is thinner and there are no weights attached to it as in 'Vichuda jal'. The *modus operandi* is the same as for the pomfret net, the difference being that the net does not sink to the bottom of the sea but remains in the surface waters acting as a surface drift net. The net is operated day and night. Catches during day include also Rawas (*Polynemus* spp), Adadia (*Parastromateus niger*) and big Boi (*Mugil* spp). 'Palwa jal' season is from October to November and again from the end of April to May. The net is generally operated in the seas near the ports and the boats return every 24 hours. But occasionally the fishermen follow the shoals into deeper waters and remain in the sea fishing for a fortnight.

Both Hilsa and Pomfret nets are tanned with 'Sajjad Chal' (bark of *Terminalia tomentosa*) thrice a week.

Buthar Jal.—(Shark net) operated in the seas opposite Madhwad port by the Kharvas is a wall net of twisted hemp consisting of 30 to 35 pieces, each 30 fathoms long and $1\frac{1}{2}$ to 2 fathoms deep. The mesh measures $9''$ knot to knot. The headrope made of coir is about $\frac{1}{2}''$ thick and is passed through the marginal meshes and fastened to it by means of cotton thread at distances of about 3 feet. Thick pieces of wood which form the floats are tied to this rope. The foot rope is also of coir and is passed through the marginal meshes at the bottom loosely and tied to it at distances of about 3 feet. This net is meant to catch bottom fishes and so is moored on the sea bottom by means of iron or stone anchors in such a way that half its breadth spreads on the bottom and the other half stands vertical. As in the other 2 nets fishes get entangled in the Buthar jal also. The fishermen return to the shore after shooting the net. Every 24 hours it is hauled up. The catches consist of sharks, rays and skates. This net is tanned once in two months.

Gholu Jal.—While the 3 nets described above are specially meant for the capture of particular types of fishes the Gholu jal is a bag-net meant to capture almost anything the tide brings in. (Fig. 1). They are operated only by the Machis in the muddy grounds near the rocky shoals in the Madhwad Bay at depths of 9 to 12 fathoms. The net is a large conical bag 150 feet long with a wide mouth the circumference of which is about 250 feet. It is made of twisted hemp and has the margin of the mouth strengthened by coir rope 1 inch in diameter. The cod end is long and made of thicker twine and in some cases the meshes of this portion are made of double threads. The net is made in one piece and the size of the mesh decreases gradually from 4″ at the mouth to ¼″ at the cod end.

At the beginning of the season 2 piles of 20 to 25 stones, each perforated in the centre for the passage through of ropes and weighing 100 to 120 lbs. are constructed about 45 feet apart on the fishing grounds. They form permanent and stationary anchors for the net. Each pile has secured to it a thick rope, about 7″ in circumference made of palmyra leaf fibre. The length of this rope depends on the depth of the water at the fishing spot. The free end of this rope is kept near the surface by means of a big piece of wood tied to it. Each 'hoda' takes three nets at a time. They are shot at the beginning of high or low tides. The free ends of the anchor ropes are taken aboard and tied to the two lower corners of the mouth of the net. The upper side is kept afloat by two wooden casks fastened to the two upper corners of the mouth of the net. Some fishermen use only one cask which is tied to the middle portion of the upper margin, in which case two pieces of wooden floats are also fastened to the two upper corners. The opening of the cod end is closed by means of a rope to prevent the escape of fish caught. Now it is ready to be set. The cod end is first thrown overboard and then the whole net is slowly paid out. The lower portion of the mouth of the net sinks down by its own weight and that of the ropes tied to it. (Fig. 1). With the turn of the tide the nets are hauled up. The four corners are quickly collected together and taken aboard to prevent the escape of big fishes. The whole net is then gathered and the catches emptied into the boat through the cod end after untying the rope closing it. If the catches are encouraging the nets are set again, thus remaining at sea for 2 to 3 tides. Fishes of all sizes ranging from big Ghol (*Sciaena*) to Gulchi (young ones of *Harpodon*) and Kolmi (*Acetes*) are caught.

The destructive nature of this net is shown by the large quantities of immature Pomfrets, Bombay ducks and Jew fishes landed every day. But for its successful operation a strong tidal current is necessary and so catches are scanty from the seventh to the eleventh and from the twenty-second to twenty-sixth day of the lunar month. The current being weak then, the hinder part of the net sinks to the bottom, preventing fish from entering it. Another disadvantage is that the fishing is restricted to areas where the anchors are constructed. But generally fishermen prepare two or sometimes three sets of such anchors at different depths from 5 to 12 miles away from the shore.

FISHES

The more important species of fish that constitute the fisheries of the coast are listed below:—

No.	Vernacular name	Scientific name
1	Moosi ...	*Scoliodon sorrakowah* (Cuv.)
2	Loda ...	*Carcharinus hemiodon* (Val.)
3	Moosi ...	,, *dussumieri* (M. & H.)
4	,, ...	,, *menisorrah* (M. & H.)
5	Magar Magra ...	,, *limbatus* (M. & H.)
6	Boovar ...	*Galeocerdo rayneri* McDnld.
7	Pattari ...	,, *tigrinus* M. & H.
8	Kanner ...	*Sphyrna blochii* (Cuv.)
9	Jowla ...	,, *zygaena* (Linn.)
10	Hanoth ...	,, *tudes* (Val.)
11	Dundimagar ...	*Atelomycterus marmoratum* (Bennett)
12	Ranjan ...	*Pristis zysron* (Blkr.)
13	Buthar ...	*Rhynchobatus djeddensis* (Forsk.)
14	Lanj, Chethar ...	*Rhinobatus granulatus* (Cuv.)
15	Jangeru ...	*Narcine timlei* (Schn.)
16	,, ...	*Astrape dipterygia* (Schn.)
17	Tharabla, Boor ...	*Dasyatis sephen* (Forsk.)
18	,, ,, ...	,, *kuhlii* (M. & H.)
19	Kandwa ...	,, *bleekeri* (Blyth)
20	Tharabla, Patra ...	,, *walga* (M. & H.)
21	Shevta ...	*Pteroplatea poecilura* (Shaw)
22	Kodio ...	*Aetobatis narinari* (Euphr.)
23	Bamin, Salo ...	*Myliobatis nieuhofii* (Bl. Schn.)
24	Karaj ...	*Molulu diabolus* (Shaw)
25	,, ...	,, *kuhlii* (M. & H.)
26	Vam ...	*Muraenosox talabon* (Cuv.)
27	,, ...	,, cinereus (Forsk)
28	Khaga, Shingala ...	*Arius caelatus* (C. & V.)
29	Gaga ...	*Osteogeniosus militaris* (Linn)
30	Dai ...	*Chirocentrus dorab* (Forsk.)
31	Palwa, Palwi ...	*Hilsa ilisha* (H. B.)
32	Choksi ...	*Clupea toli* (C. & V.)
33	Katta ...	*Pellona filigera* (C. & V.)
34	Katti ...	*Opisthopterus tartoor* (C. & V.)
35	Pattu ...	*Chatoessus modestus* Day
36	Poophan ...	*Megalops cyprinoides* (Brouss)
37	Netla, Talar ...	*Engraulis purava* (C. & V.)
38	,, ,, ...	,, *mystix* (Bl. Schn.)
39	Mendli, Madeli ...	*Coilia dussumierii* (C. & V.)
40	Bumla, Bumli, Gulchi ...	*Harpodon nehereus* (H. B.)
41	Kagda ...	*Hemirhamphus far* (Forsk.)
42	,, ...	,, *limbatus* (C. & V.)
43	Veku ...	*Cromileptes altivelis* (C. & V.)
44	Koonth, Datia ...	*Serranus* sp.
45	Damra ...	*Lutianus roseus* Day
46	Rathad, Rathda ...	,, *johnii* (Bloch.)
47	Hajamda ...	*Therapon jarbua* (Forsk.)
48	Tiperva ...	*Pristipoma furcatum* (Bl. Schn.)
49	Peradi ...	*Diagramma* sp.
50	Pincheta, Kitlo ...	*Gerres lucidus* (C. & V.)
51	Pichuda ...	*Pentaprion longimanus* (Cantor)
52	Sungeli ...	*Scatophagus argus* (Bloch.)
53	Tiparwa ...	*Chrysophrys cuvieri* Day
54	Rawas ...	*Polynemus heptadactylus* (C. & V.)

No.	Vernacular name	Scientific name
55	Rawas ...	*Polynemus indicus* Shaw
56	,, Pin ...	,, *tetradactylus* Shaw
57	Ghol, Gholar ...	*Sciaena miles* (C. & V.)
58	Ghol ...	,, *sina* (C. & V.)
59	Tura ...	*Otolithus ruber* (Bl. Schn.)
60	Baga, Bagi ...	*Trichiurus muticus* Gray.
61	Patta, Patti ...	,, *savala* (C. & V.)
62	Bangda ...	*Caranx hippos* (Linn)
63	Chank ...	*Chorinemus moadetta* (C. & V.)
64	,, ...	,, *lysan* (Forsk)
65	Charala ...	*Equula dussumieri* (C. & V.)
66	Chandla ...	,, *edentula* (Bl.)
67	,, ...	,, *fasciata* (Lacép.)
68	Kitley ...	*Lactarius delicatulus* (C. & V.)
69	Vichuda, Chamanya ...	*Stromateus sinensis* (Euphr.)
70	,, ,, ...	,, *cinereus* (Bloch.)
71	Adadia ...	*Parastromateus niger* (Bloch.)
72	Chapra, Chapri ...	*Cybium* sp.
73	Nanchi ...	*Echeneis neucrates* (Linn.)
74	Sing ...	*Sillago sihama* (Forsk.)
75	Gokharu ...	*Platycephalus carbunculus* (C. & V.)
76	Kund ...	*Sphyraena* sp.
77	Boi, Pambida ...	*Mugil seheli* (Forsk.)
78	,, ,, ...	,, *oligolepis* (Bleeker.)
79	,, ,, ...	,, *waigaiensis* (Q. & G.)
80	Motijib, Solfis ...	*Psettodes erumei* Bl. Schn.
81	Jib, Bhamed, Solfis ...	*Pseudorhombus arsius* (H. B.)
82	Jib, Solfis ...	*Cynoglossus sindensis* Day.
83	Popicha ...	*Tetrodon oblongus* (Bloch.)

The other constituents of the fisheries here are Chola or Jinga (*Penaeus carinatus, Penaeus indicus, Metapenaeus monoceros*), Tettan (*Panulirus*), Dedki (*Sepia* spp.) and small quantities of crabs and Squilla. Pomfrets form the most valuable fish on the coast and they occur in large shoals from October to May with the peak period in April-May. Ghol, Vam, Bumla and Jinga are caught in large numbers from October to February and are rare thereafter, October is the peak for the Bumla season in Kotda and January to May in Madhwad. Palwa and Choksi appear in huge shoals from September to December and again from March to May. Other fishes are available all through the season in moderate quantities. During March and April young ones of Bombay ducks of $1\frac{1}{2}''$ to $3''$ size are caught in enormous quantities as also young ones of the three species of pomfrets of $2''$-$3''$ size. As no records are kept of the quantities of fish caught on the coast it is not possible to assess the productivity of the fishing grounds. Not less than 80% of the catches are exported and the export figures will give a rough idea of the present yield. Tables I to IV show the approximate quantities of fish exported by sea from the 2 main ports of the coast with their value as calculated from the Customs records.

Recent years have witnessed considerable fluctuations in the yield of this coast. Strong winds, clear water or preponderance of jellyfish are often believed by the fishermen to be the reasons for

scanty catches. An interesting phenomenon reported during the season of 1947 was the abnormally low catches till about 4 days before the cyclone that lasted for 3 days from the 16th of April when an abrupt rise in the catches, especially of pomfrets was observed. Fishing boats returned to ports packed to capacity with pomfrets and they were sold in the ports of South Kathiawar at 4 and 5 per rupee.

The major portion of the prime fish are exported to Bombay by the merchants in fresh condition packed in ice, by country craft. There are two ice factories with cold storage facilities, one at Velan and the other at Kodinar. Ice is also brought from Bombay in the country craft when they return after delivering the fish consignments. With favourable winds the journey from these ports takes only 24 to 36 hours but considerable delay is caused when weather conditions are unfavourable and the consignments reach the destination in a deteriorated condition. The bigger fishes when landed in a stale state are cured by the fishermen or merchants. Both dry as well as wet curing methods are followed. Ghol and Vichuda are often wetcured. The proportion of salt used varies but is generally 1:2. Dry curing is done in shallow square pits lined with matting and the curing time is from 24 to 72 hours. Flesh of sharks and Ghol are sometimes filleted and cured for export. Prawns are always shelled and cured with salt. Bombay ducks are simply dried in the sun hung in pairs on ropes. Gulchi the young of Bumla, Mendley, Patti, Bagi, Netla, Tura and Kolmi as also Dedki are simply sun-dried.

Bye-products

Tura, Mendley, Gulchi, prawn shells and offal of large fishes are sundried and exported as manure. 11,032 maunds of fish and prawn manure costing about Rs. 29,500 were sent out from Madhwad and Kotda during 1945-46. The fins of sharks are also exported to Bombay from where they are re-exported to China—this trade had a setback because of war—where they are in great demand for the preparation of soup. Fins worth Rs. 998-13 were exported during 1945-46 from this coast. Another bye-product of importance is the fishmaw obtained mainly from Ghol (*Sciaena*) Khaga (*Arius*) Vam (*Muraenosox*). The airbladder is removed in as fresh a condition as possible and after soaking in water for sometime the inner vascular layer is removed. The bladders are then dried in the sun on special barbecues of coirnetting. Ghol gives the best fishmaws and cost 9 annas per piece; Kaga maws cost Rs. 5 per maund and the Vam maws 2 annas each. 34,287 pounds costing Rs. 12,723-8-6 were exported from this coast during 1945-46. These two are first sent to Bombay from where they are shipped to England or China.

Rules Relating to Fish Trade

Fishing in the Kodinar seas is allowed to fishermen on permits obtainable from the Port Officer on payment of the following fees:—

1. Rs. 12 annually for every fishing boat with a capacity of 5 or more tons.

2. Rs. 2 monthly for boats of less than 5 ton capacity but not under 3 tons.

3. Rs. 1-8 per month or part thereof for boats of 3 ton capacity or less.

Fishermen who have obtained permits are allowed the free use of land for building huts and drying nets and are also exempted from the payment of local cess or mooring charges and customs duty on provisions brought by them for consumption or for use in connection with their trade. Those fishermen who, like the Kharavas of Vanakbara, do not occupy any lands but only land their catches at the ports have to pay Rs. 2 to the Government and they are given sufficient space in the port area to erect huts.

Government have laid down certain provisions for regulating the transactions between the fishermen and the merchants. All tradesmen wishing to export fish and entering into a contract for purchasing fish from fishermen for the purpose, have to deposit with the Customs Officer a sum of Rs. 100 for each boatload of commodity to be exported or provide a security bond for the amount. The Kodinar port officer who is also the Revenue officer of the Taluka, fixes the rates for the different kinds of fish before the beginning of each season, on the basis of which export duties are to be levied. The fishermen and merchants are required to enter into a contract between themselves for the sale and purchase of fish at the rates fixed. The fishermen however charge only rates lower than those fixed and this is permissible under the rules. The merchant has to pay 75% of the price of the commodity purchased by him in cash to the fishermen before exporting it and the balance of 25% has to be paid within a fortnight of the despatch. If a tradesman fails to settle his account with a fisherman within a prescribed period the amount due from him is liable to be recovered from his personal property or surety. Rentfree land is assigned to tradesmen and labourers for the purpose of erecting huts to the extent of 200 square yards per hut in the case of the former and 50 square yards in the latter. However every fish merchant has to pay an annual charge of Rs. 5.

Conclusion

Sustained efforts to improve the quality of preserved fish and develop the bye-product industries have been made, since the opening of the Fisheries Department in 1937, though the experiments conducted for a decade from 1916 by Mr. Dotiwala and later stopped had the same object. At Kotda the Department of Fisheries runs a model fish-curing yard with a smoker and a drier and here a scheme for the preservation of fish by smoking, pickling and curing according to some special recipes, started with an initial part-grant from the Imperial Council of Agricultural Research, is being worked. Shark liver oil is extracted at the Fisheries Stations at Madhwad and Kotda. One important activity of the department aims at the improvement of the socio-economic condition of the fisherfolk. Here the main handicap to fishery development is the paucity of local fishermen, and to solve this problem the Government have sanctioned a colonisation scheme to induce fisher people to settle

at Kotda by the grant of concessions ashore such as lands, huts, salt for curing etc. and the use of a launch at sea. A small party of fishermen came and stayed for some time in 1944 but they did not settle down permanently. At Muldwaraka a co-operative society for the Machiaras was formed last year and these men are conducting fishing and marketing on their own without the interference of middle men. The latest development is the floating of a limited company—the Western India Fisheries Ltd., with a capital of 5 lacs to which the State Government will contribute a lac. The company when it starts functioning will do intensive fishing and expand fish trade by putting up huts for fishermen, building fishing boats and supplying the men with boats and nets. The company would install cold storage stations, canneries, smoke houses, manure factories etc. to deal with the catches and purchase and work power vessels for quick transport and deep-sea fishing.

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TABLE I

Statement of fresh fish exported from Madhwad Bunder by sea during the year 1945-46

Serial No.	Vernacular name of fish	Scientific name of Fish	Number	Price		
				Rs	A	P
1	Vichuda ...	*Stromateus cinereus* *S. sinensis*	5,38,067	2,69,033	8	0
2	Ghol ...	*Sciaena sina, S. miles*	4,780	16,729	8	0
3	Palwa ...	*Hilsa ilisha* ...	4,022	3,734	10	0
4	Choksi ...	*Clupea toli* ...	865	632	10	0
5	Vam ...	*Muraenesox talabonoides* *M. cinereus*	949	583	3	0
6	Koonth ...	*Serranus sp.* ...	84	521	8	0
7	Baga ...	*Trichiurus muticus*	43,000	429	6	0
8	Palwi ...	*Hilsa ilisha.* (Young ones)	1,755	365	15	0
9	Khaga ...	*Arius cælatus* ...	790	353	4	6
10	Solfish ...	*Psettodes erumei* ... *Pseudorhombus arsius* *Cynoglossus sindensis*	254	182	4	0
11	Magra ...	*Carcharinus sp.* ...	149	38	4	0
12	Vekku ...	*Cromileptes altivelis*	6	18	0	0
13	Buther ...	*Rhynchobatus djiddensis*	3	9	12	0
14	Ratda ...	*Lutianus johnii* ...	1	1	2	0
15	Miscellaneous ...		111	84	0	0
		Total ...		2,92,716	14	6

TABLE II

Statement of fish cured or dry including prawns and cuttlefish exported from Madhwad Bunder by sea during the year 1945-46

S. No.	Vernacular name of Fish	Scientific name of Fish	Number	Weight Kacha Maunds	Weight Seers	Price RS	Price A	Price P
1	Vichuda	*Stromateus cinereus, S. sinensis*	119922			29,980	8	0
2	Bumla	*Harpodon nehereus*	1295000			12,302	8	0
3	Tura	*Otolithus ruber*	...	1,607	0	6,986	12	0
4	Ghol	*Scicena sina, S. miles*	2094			5,554	11	6
5	Khaga	*Arius cælatus*	8419			3,332	5	0
6	Gulchi	*Harpodon nehereus* (young ones)	...	1,495	30	2,963	8	0
7	Kanner	*Sphyrna blochii*	7902			2,958	10	0
8	Tharabla	*Dasyatis sephen, D. Kuhlii*	...	477	10	2,743	15	0
9	Patti	*Trichiurus savala* (young ones)	394000			1,772	8	0
10	Vam	*Muraenesox telabon, M. cinereus*	1974			1,199	6	0
11	Baga	*Trichiurus muticus* (young ones)	576000			480	0	0
12	Mendley	*Coilia dussumieri*	...	51	10	256	4	0
13	Magra...	*Galeocerdo ravneri*	832			208	0	0
14	Chola	*Penaeus* sp.	...	13	30	165	0	0
15	Palwi	*Clupea toli*	333			141	10	0
16	Adadia	*Parastromatieus niger*	339			84	12	0
17	Netla	*Engraulis purava, E. mystix*	...	6	30	67	8	0
18	Dedki	*Sepia* sp.	...	33	20	67	0	0
19	Chapri	*Cybium* sp.	97			20	14	0
20	Choksi	*Clupea toli*	18			13	2	0
21	Koonth	*Serranus* sp.	2			13	0	0
22	Miscellaneous (small) ...	.....	...	12	10	124	0	0
23	,, (large) ...	.....	8			18	0	0
				Total	...	71,453	13	6

TABLE III

Statement of fresh fish exported by sea from Kotda Bunder during the year 1945-46

Serial No.	Vernacular Name of Fish.	Scientific Name of Fish.	Number.	Price.		
				RS	A	P
1	Vichuda ...	*Stromateus cinereus, S. sinensis*	1,80,181	89,281	0	0
2	Ghol ...	*Sciaena sina, S. miles*	22,689	73,781	0	0
3	Palwa ...	(*Hilsa*) *ilisha*	5,792	4,652	10	0
4	Koonth ...	*Serranus* sp.	923	4,558	2	0
5	Adadia ...	*Parastromateus niger*	5,304	2,652	0	0
6	Chapra, Chapri ...	*Cybium* sp.	8,977	2,303	5	6
7	Vam ...	*Muraenesox talabonoides, M. cinereus*	3,415	2,008	1	0
8	Solfis ...	*Psettodes erumei, Pseudorhombus arsius, Cynoglossus sindensis*	1,947	1,778	7	9
9	Khaga ...	*Arius cælatus*	2,099	804	13	6
10	Palwi ...	*Hilsa ilisha* (young ones)	2,587	634	0	0
11	Pattari ...	*Galeocerdo tigrinus*	254	630	12	0
12	Ratda ...	*Lutianus johnii*	496	529	3	0
13	Choksi ...	*Clupea toli*	514	342	8	0
14	Vekku ...	*Cromileptes altivelis*	122	338	10	0
15	Buther ...	*Rhynchobatus djiddensis*	84	281	12	0
16	Dai ...	*Chirocentrus dorab*	178	22	8	0
17	Magra ...	*Galeocerdo rayneri*	42	8	0	0
18	Bangda ...	*Caranx hippos*	9	0	6	0
19	Miscellaneous ...	.....	1,158	2,715	15	0
		Total ...		1,87,323	1	0

TABLE IV

Statement of fish dry or cured exported from Kotda by sea during the year 1945-46

S. No.	Vernacular Name of Fish	Scientific Name of Fish	Number	Weight		Price		
				K. Maunds	Seers	RS	A	P
1	Bumla ...	*Harpodon nehereus*	43,54,200	...	...	41,329	14	6
2	Tura ...	*Otolithus ruber*	—	7,620	...	26,393	8	0
3	Vichuda ...	*Stromateus cinereus, S. sinensis*	53,615	...	...	11,516	15	6
4	Palwa ...	*Hilsa ilisha*	17,671	...	...	9,683	1	0
5	Ghol ...	*Sciaena sina, S. miles*	1,546	...	...	5,312	8	0
6	Chola ...	*Penaeus* sp.	—	256	...	3,070	4	0
7	Gulchi ...	*Harpodon nehereus* (young ones)	—	1,511	...	3,027	2	0
8	Tharabla, Boor ...	*Dasyatis sephen D. Kuhlii*	—	48	...	2,731	3	0
9	Baga ...	*Trichiurus muticus*	67,200	...	...	2,645	0	0
10	Palwi ...	*Hilsa ilisha* (young ones)	8,223	...	...	2,299	14	0
11	Kanner ...	*Sphyrna blochii*	3,104	...	...	2,225	14	0
12	Patti ...	*Trichiurus savala* (young ones)	3,28,000	...	...	1,475	7	0
13	Khaga ...	*Arius cœlatus*	7,357	...	...	1,647	6	0
14	Chapra, Chapri ...	*Cybium* sp.	3,982	...	...	1,213	6	0
15	Jowlo ...	*Sphyrna malleus*	—	468	30	937	7	0
16	Adadia ...	*Parastromateus niger*	3,371	...	...	815	0	0
17	Magra ...	*Galeocerdo rayneri*	1,310	...	...	708	5	0
18	Vam ...	*Muraenesox talabonoides, M. cinereus*	851	...	...	521	0	0
19	Netla, Talar ...	*Engraulis purava, E. mystix*	—	51	...	508	12	0
20	Buther ...	*Rhynchobatus djiddensis*	483	...	...	180	2	0
21	Choksi ...	*Clupea toli*	116	...	...	67	11	0
22	Ratda ...	*Lutianus johnii*	36	...	...	45	6	0
23	Bangda ...	*Caranx hippos*	1,384	...	...	40	2	0
24	Fillets ...	... ...	—	7	20	30	0	0
25	Dai ...	*Chirocentrus dorab*	234	...	...	28	0	0
26	Koonth ...	*Serranus* sp.	1	...	...	6	0	0
27	Miscellaneous (small)	... ...	—	72	...	717	14	0
28	,, (large)	... ...	2,402	...	...	425	14	0
		Totai ...	...	...	...	1,19,603	0	0

Note.—The prices are calculated as per the rate fixed by the Port Officer for purposes of levying customs duties. The bigger fishes are charged according to number and smaller ones by weight.

MORE BUTTERFLIES OF THE ARAKAN COAST

BY

MAJOR A. M. EMMET, M.A., M.B.E.

I read Major Gladman's list (Some Butterflies of the Arakan Coast, Vol. 46, No. 3, p. 516) both with pleasure and a sense of disappointment. While we were in Arakan we were both members of XV Indian Corps and on occasions we must have been close neighbours. Therefore it is a real pity that we did not meet or know of each other's activities; and it is also unfortunate that we were not able to pool our resources and produce a joint list of the butterflies of the district. Since we were denied the pleasure of collaboration, I feel the most useful thing I can do is to build on Major Gladman's foundation and supplement his interesting notes.

I have therefore divided my list into two parts. The first part gives additional information about species included in Major Gladman's work. I have mentioned additional localities and new months of appearance for uncommon species, and have in one or two cases corrected what I believe to be a false estimate of a butterfly's degree of abundance. I have also added by families the names of the thirty species and forms in Major Gladman's list which I did not encounter myself. I believe this negative information may be of value to any naturalist who is studying distribution; had the species been common in the areas where I collected I would almost certainly have met with them. Moreover several of them were recorded only from Ramree Island, which is further south than any of the places I visited.

The second half of my list is devoted to new species and forms, of which I am able to add 111. The catalogue for this region is still far from complete; I cannot agree with Major Gladman's claim that his list is 'fairly comprehensive' for dry season broods. I always found it difficult to take out a net into a new area of jungle without making some fresh capture. Owing to the fact that my division was in contact with the enemy throughout the year I spent in Arakan, I was seldom able to wander abroad freely or devote much time to entomology. Most of my species were taken in surreptitious half-hours in the vicinity of our camps, and only once or twice was I able to make an expedition to some chosen locality. Had I been at liberty to collect intensively, the list would have been very much longer.

In imitation of Major Gladman I give a brief description of the areas and circumstances in which I made my observations. Like him I include records from South-eastern Bengal as well as from Arakan proper.

South-eastern Bengal

Chittagong. Open paddy and scrub.	Two short afternoons, one in February and the second in March, 1944.
Cheringa. About 50 miles south of Chittagong. A fairly large area of evergreen jungle.	Two days in March 1944.
The Teknaf Peninsula. Evergreen jungle.	Visited for a single afternoon in each of the months of May, August and September 1944

Burma

Maungdaw and the immediate neighbourhood. Coastal plain consisting of paddy with small topes and ruined villages.	Late March to October, 1944. I did no real collecting until towards the end of July when the rains began to slacken. There were relatively few species to be had in this open country.
The Mayu Range. The foothills were clad in scrub, and the 'Spine', which reached nearly 2,000 feet at its highest point in our area, was covered in bamboo and evergreen jungle.	Our Headquarters moved to the foothills in late October, 1944 and we finally left the area at the end of the year. Though I constantly visited the 'Spine', I was seldom able to collect there, except for one good day in October when one of our battalion commanders provided me with an armed escort. I wonder what the sepoys thought!
Akyab Island. Country very similar to the Maungdaw coastal plain.	I was there for a brief and busy spell in January, and for an idle week at the end of March, 1945. In the latter month the topes which were not full of soldiers held plenty of butterflies, particularly *Euploeae*.
Myebon. Evergreen and mixed jungle, and paddy.	From mid-January till the end of February. A good area for collecting.
Kangaw. Country similar to that at Myebon.	February. Collecting was almost impossible owing to the intensity of the battle, but I obtained some good specimens in its closing stages.
Ru-ywa. Evergreen and mixed jungle.	March 1945. Butterflies were very plentiful, and I saw many species which I could not capture or identify.

I was on leave in June, at the height of the monsoon, and have no observations for that month. In late July and August, when the rains began to ease a little, butterflies were very plentiful and continued so until mid-November. From then until mid-January few

except for the most common and hardy species were to be seen. February and March were again good months, but, I think, numbers diminished in April and May.

I have tried to give only positive information in my notes, and have not made inferences such as 'generally distributed' or 'common' except where my information has warranted it. It must not therefore be thought that my assertion that a butterfly is to be taken at a certain place and at a certain time of year excludes other places and other months. For example, under No. 164 *Papilio helenus helenus* L. I say that it is common at Teknaf and on the Mayu Range from August to October. For all I know, it is also found in suitable jungle throughout the whole of the coast of Arakan, and there may well be a pre-monsoon emergence, say in April and May, which I failed to record, having been rather preoccupied in making war during those months.

I have copied Major Gladman in giving before each species its code number in Brigadier Evans' *Identification of Indian Butterflies*. I have also followed the latter's nomenclature throughout, though I am aware that the names of certain species have been revised since that work was published.

I conclude my list with a fresh analysis of species and forms (I would have preferred not to give the latter equal standing with the species). An active collector, working under conditions of peace, might well add a further hundred species to our total.

A.

ADDITIONAL NOTES ON THE SPECIES INCLUDED IN MAJOR GLADMAN'S LIST.

Papilionidae

1. A 1-1y **Troïdes helena carberus** Fd.

I can confirm the identification, and add that it is not rare throughout the area. It was conspicuous in the Mayu Peninsula towards the end of monsoon (late July to September). I also recorded it from Cheringa and Akyab in March, and from Myebon in January. My ♂♂♀ from Akyab seem to be referable to *P. eumagos* Jord, being almost completely without the white vein stripes on the forewing.

14. A 6-3y **Zetides doson axion** Fd.

I took it at Cheringa in March and at Teknaf in August.

I did not encounter the following Papilionids in Major Gladman's list; 2. *Tros hector* L; 9. *Papilio polytes romulus* Cr. ♀. *v. cyrus* F; *demoleus malayanus* Wall.; 12. *Pathysa nomius swinhoe* M.; 13. *P. antiphates pompilius* F.

Pieridae

17. B 4-10β **Pieris canidia indica** Evans.

I did not meet with it south of Cheringa.

19. B 6-11. **Delias descombesi leucacantha**, Fruh.

I was more fortunate than Major Gladman with the ♀, which I found in approximately equal numbers with the ♂.

25. B 11-1. **Catopsilia crocale** Cr.

26. B 11-2. **Catopsilia pomona** F.

I took *crocale* both in the wet and the dry season, but *pomona* in the dry season only. I am inclined to consider the species as distinct.

I did not encounter 24. *Appias paulina adamsoni* M. or 33. *Eurema lacteola sarinoides* Fr.

DANAIDAE

37. C 2-2. **Danais agleoides** Fd.

I took one at Akyab and one at Ru-ywa, both in March. It is possibly a fairly common species, and I may have overlooked it on many occasions owing to its close resemblance to the common *D. aglea melanoides* M.

44. C 3-2♂. **Euploea alcathoe doubledayi** Fd.

Not common, but generally distributed from the Mayu Peninsula southwards. I observed or took specimens in February, March, October and November.

48 C 3-10♂. **Euploea deione deione** Wd.

Rare, but apparently widely distributed. I have two specimens from the Mayu Peninsula, taken in November, and one from Ru-ywa, taken in March.

I did not take 39. *Danais gautama gautama* M.

SATYRIDAE

58. D 16β. **Orsotriocna medus medus** F.

I also found it uncommon, taking only the dry season form sparingly at Cheringa and Myebon from January to March.

I did not take 54. *Myealesis visala neovisala* Fruh., or 55. *Lethe rohria rohria* F.

NYMPHALIDAE

64. F 18-3γ. **Euthalia lepidea sthavara** Fruh.

In my experience a common species, especially between January and March. On the other hand, I met with 66 *E. garuda garuda* M. only sparingly in the Maungdaw plain between August and October.

68. F 20·γ. **Parthenos sylvia gambrisius** F.

It was most plentiful in the Mayu Peninsula in August and September, when the rains began to slacken.

73. F 26-1β. **Neptis columella ophiana** M.

I did not meet with it north of Ru-ywa, where it was common.

78. F 26-8β. **Neptis nandina susruta** M.

I can add Cheringa and Kangaw as localities, and February and March as months of appearance. Though I met with this species seldom, and with *N. soma soma* M. not at all, I feel I may have overlooked them through their similarity to the abundant *hylas*.

82. F 31. **Yoma sabina vasuki** Doh.

I did not find this butterfly north of Ru-ywa.

94. F 47-3. **Cethosia cyane** Drury.

I can add a February record, but I agree that it became very scarce after Christmas.

I did not encounter the following Nymphalids :—

95. *Euthalla jahnu jahnu* M. 67. *Adollas dirtea jadeltina* Fruh. 72. *Pantoporia cama* M. 77. *Neptis soma soma* M. 91. *Issoria sinha sinha* Koll. 92. *Cirrochroa fasciata* Fd.

I saw 83. *Doleschallia bisaltide indica* M. on several occasions, but failed to secure a specimen.

ERYCINIDAE

98. G 4-5γ. **Abisara echerius angulata** M.

I never observed it north of Foul Point (the southern tip of the Mayu Peninsula). From there southwards it was very common.

LYCAENIDAE

104. H 13. **Syntarucus plinius** F.

I did not meet with this species north of Ru-ywa.

112. H 27-2. **Catachrysops lithargyria** M.

In my experience *lithargyria* was common from November to February, and much more plentiful than *C. strabo* F.

122. H 46-1δ. **Horsfieldia anita arracana** Grs.

I took only a single specimen of this species at Teknaf in October.

125. H 49-32β. **Amblypodia agaba agaba** Hew.

Agaba seems to be the race at Akyab and at Myebon.

126. H 49-36γ. **Amblypodia centaurus centaurus** F.

127. H 49-39ζ. **Amblypodia amantes amantes** Hew.

In my experience it was locally common rather than general. I did not meet with it at all between Cheringa and Ru-ywa. I took *amantes* only at the latter locality.

132. H 70*γ. **Cheritra freja freja** F.

I concur that it is rare. I can add Cheringa and the Ngakyedauk Pass as localities, and November as an additional month of appearance.

I seem to have been more fortunate in finding the various species of *Hypolycaena*, *Deudoryx* and *Rapala*, (Nos. 133-137) given in Major Gladman's list. Myebon was an excellent locality for them. I regard *H. erylus himavantus* Fruh. in particular as widely distributed and fairly common butterfly.

138. H 87-β. **Bindahara phocides phocides** F.

Another rare butterfly. I saw it on the Mayu Range in October and took it at Myebon in January.

I did not meet with the following species :—105. *Chilades laius laius* Cr.; 108. *Euchrysops cnejus* F.; 109. *Epandava pandava* Hors.; 121. *Curetis thetis* Drury; 123. *Amblypodia khamti* Doh.; 124. *A. agaba aurelia* Evans; 130. *Spindasis lohita himalayanus* M.; 131. *Tajuria melastigma* DeN

HESPERIIDAE

139. I 1-7β. **Hasora badra badra** M.

I found *badra* only once, namely in heavy jungle at Cheringa.

146. I 21-3 γ. **Sarangesa dasahara dasahara** M.

Fairly common throughout the coastal area from Chittagong southwards. I recorded it from January to March, and in October.

147. I 25-1. **Odontoptilum angulata sura** Fd.

I agree that it is rare. I took only a single specimen at Ru-ywa in March.

149. I 43-9. **Aeromachus pygmaeus** F.

Common from Chittagong southwards, especially in February and March. It also flies from August to November. I concur with Major Gladman's verdict on the other species he has grouped with *pygmaeus*.

I did not take the following species of Hesperiidae:—140. *Hasora taminatus bhavara* Fruh.; 141. H. *alexis alexis* F.; 142. *Ismene mahintha* M.; 155. *Unkana attina* Hew.; 156. *Astycus augias augias* L.; 158. *Baoris conjuncta javana* Mab. I did not take 153. *Gangara thyrsis thyrsis* F. either, but I saw what I am sure was this butterfly on a number of occasions at Ru-ywa, and achieved several misses.

B.

SPECIES NOT INCLUDED IN MAJOR GLADMAN'S LIST

Papilionidae

4 A3-5γ. **Chilasa clytia onpape** M.

160. v. **janus** Fruh.

One at Ru-ywa in March.

6. **A4-2. Papilio memnon agenor** L.

161. ♀ v. **butlerianus** Roth.

One in the Ngakyedauk Pass (Mayu Peninsula) in November.

162. ♀ v. **alcanor** Cr.

One at Teknaf and another at Maungdaw in August, and I saw it on several other occasions. I would suggest tentatively that this is the commonest form of the ♀ in the Mayu Peninsula. Major Gladman seems to have met with only the typical ♀ which I never encountered. This butterfly apparently ceases to fly in November, and I did not see it at all during the dry season.

163. A4-18β. **Papilio castor castor** Wd.

One ♀ at Cheringa in March. What I suppose to have been the ♂ was also on the wing, and fairly plentiful.

164. A4-19γ. **Papilio helenus helenus** L.

Common at Teknaf and on the Mayu Range at the end of the wet season (August to October).

Pieridae

165. B6-12. **Delias aglaia** L.

I am convinced that I saw this butterfly at Cheringa, Myebon and Ru-ywa, but since I took no specimen, I cannot confirm the identification.

166. B 10-4β. **Appias libythea olferna** Swin.

Not common. I took it at Cheringa, Maungdaw and Myebon in the following months:—DSF[1], December, February and March; WSF, August.

36. B20-3. **Pareronia valeria hippia** F.

167. ♀ v. **philomela** F.

I watched a specimen of this handsome variety for some time at Myebon in February.

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[1] DSF = dry season form; WSF = wet season form.

DANAIDAE

168. C1-1δ. **Hestia lynceus arracana** Fruh.

Not rare locally in the mangrove swamps at Kangaw in February, but I did not see this conspicuous butterfly elsewhere.

169. C2-1β. **Danais aglea melanoides** M.

I took one at Teknaf in September, and found it common at Akyab, Myebon, Kangaw and Ru-ywa from January to March.

170. C3-7γ. **Euploea core vermiculata** But.

Common and general as far south as Ru-ywa. I never saw *E.c. layardi* Druce.

171. C3-11♂. **Euploea harrisi hopei** Fd.

Fairly common at Akyab in March. One from Ru-ywa in the same month.

SATYRIDAE

172. D2-3β. **Mycalesis anaxias aemate** Fruh.

Not rare in thick jungle in the Mayu Peninsula at Kangaw and at Ru-ywa, September-November and February-March.

173. D2-16β. **Mycalesis khasia khasia** Evans.

174. D3-21β. **Lethe europa niladana** Fruh.

I took several specimens of each species at Ru-ywa in March.

175. D-3 28β. **Lethe makara zuchara** Fruh.

176. D3-37. **Lethe vindhya** Fd.

Both seem not rare throughout the area. I took *mekara* in December, February and March, and *vindhya* in October and March.

177. D3-38. **Lethe kansa** M.

I recorded this butterfly only in the Mayu Range in October.

178. D21-1. **Anadebis himachala** M.

Not rare in the Ngakyedauk Pass (Mayu Range) in November.

179. D22-2δ. **Malanitis phedima ganapati** Fruh.

One at Ru-ywa in March.

180. D32-3δ. **Melanitis zitenius anletes** Fruh.

One in bamboo jungle at Kangaw, February.

181. D25-7♂. **Elymnias nisaea timandra** Wall.

182. D25-11. **Elymnias penanga chelensis** DeN.

183. D25-12γ. **Elymnias vasudeva burmennsis** M.

I took one specimen of each species, all in March. My *penanga* is from Cheringa, and the other two from Ru-ywa.

AMATHUSIIDAE

184. E5-1. **Thaumantis diores** Db.

One in the Ngakyedauk Pass in November.

185. E7♂. **Amathusia phidippus friderici** Fruh.

One at Ru-ywa in March. I have no doubt that I saw several other Amathusiids but I was unable to secure them. I was luckier than Major Gladman with *Discophora tullia zal* Wd.

NYMPHALIDAE

62. F1-2♂. **Charaxes polyxena hierax** Fd.

186. ♀ **v. corax** Fd.

One at Ru-ywa in March. I found *hierax* scarce and hard to capture.

187. F1-4. **Charaxes marmax** Wd.

I secured one in October, which was desporting itself in a very active manner at the extreme summit of the highest peak of the Mayu Range in our area.

188. F2-3. **Eriboea arja** Fd.

Common at Cheringa and in the Mayu foothills in November and from February to March. In my experience *arja* was more commonly to be found in low, damp valleys, while *athamas* preferred higher ground and heavier jungle.

189. F18-6♂. **Euthalia julii sedeva** M.

Not rare in the Mayu Range at Myebon from September to January.

190. F18-15♂. **Euthalia jama verena** Fruh.

Not rare in the Mayu Peninsula from September to December.

191. F18-16. **Euthalia phemius** Db. & Hew.

One at Cheringa in March.

192. F18-27♂. **Euthalia evelina derna** Koll.

I saw this butterfly on several occasions at Myebon in February, but failed to obtain a specimen.

193. F18-30♂. **Euthalia teuta teuta** Db. & Wd.

Although I secured only a single specimen, it was locally not uncommon at the extreme summit of the Mayu Range.

194. F19-2β. **Adolias khasiana intermedia** Tyt.

Locally not rare in thick jungle. I took specimens at Cheringa, on the Mayu Range and at Kangaw in October and November, and again in February and March. I never saw *A. dirtea jadeitina* Fruh.

195. F25-14. **Pantoporia perius** L.

One in the Mayu foothills in November.

196. F26-12. **Neptis harita** M.

Fairly general in the Mayu Peninsula, but not common: also Teknaf, October to November.

197. F26-28. **Neptis paraka** But.

Two in medium jungle at Myebon, February.

198. F28-1. **Chersonesia risa** Db. & Hew.

One in the Ngakyedauk Pass. November.

ERYCINIDAE

199. G5-2. **Taxila haquinus fasciata** M.

Two or three at Cheringa in March

LYCAENIDÆ

200. H2-5♂. **Poritia hewitsoni hewitsoni** M.

Rare. I took it in the Mayu Range in September and December, and at Kangaw in February.

201. H5-4. **Gerydus longeana** DeN.

Two in the Mayu Range in December.

202. H6-3. **Allotinus horsfieldii continentalis** Fruh.

Common at Cheringa in March.

203. H12-1. **Tarucus ananda** DeN.

Rare. I only came across it by a stream in the Ngakyedauk Pass.

204. H12-9. **Tarucus nara** Koll.

Not rare in the coastal plain round Maungdaw in April and again from July to September.

205. H17. **Neopithecops zalmora** But.

General and fairly common in thick jungle. I noted it from August to October, and in December, January and March.

206. H18-5β. **Everes parrhasius assamica** Tyt.

I took it only at Chittagong in March.

207. H20β. **Megisba malaya sikkima** M.

One at Myebon in February.

208. H24-1♂. **Zizeeria trochilus putli** Koll.

Rare. Taken only at Myebon in February.

209. H24-3β. **Zizeeria maha maha** Koll.

Several at Chittagong in March.

210. H24-5. **Zizeeria gaika** Trimen.

Not rare south of Akyab—February and March.

211. H26-2β. **Lycaenesthes lycaenina lycambes** Hew.

I took two in the Ngakyedauk Pass in November, and imagine it to be fairly common there.

212. H32-5. **Nacaduba pavana** Hors.

Rare. I took it at Myebon in February and March.

213. H32-7β. **Nacaduba helicon merguiana** M.

Rare. I took one in the Ngakyedauk Pass in November.

214. H32-12β. **Nacaduba berenice plumbeomicans** WM & DeN.

One at Myebon in February.

215. H32-16β. **Nacaduba dubiosa sivoka** Evans.

Common. The DSF, which is very distinct, is as described by Evans.

216. H32-19. **Nacaduba dana** DeN.

Not rare at Myebon in late January and February.

217. H44-2♂. **Curetis saronis gloriosa** M.

Not rare in the Mayu Peninsula in March and July–August. I did not see *thetis*.

218. H45-1γ. **Iraota timoleon timoleon** Stoll.

One ♀ from the coastal plain at Maungdaw : August.

219. H49—1[a]. **Amblypodia epimuta elsiei** Evans.

One at Myebon in February.

220. H49-31♂. **Amblypodia alea alea** Hew.

One at Teknaf in October.

221. H49-42♂. **Amblypodia eumolphus eumolphus** Cr.

Common at Cheringa, Tumbru and Teknaf in March, and from July to October.

222. H49-63♂. **Amblypodia perimuta perimuta** M.

I took two at Cheringa in March, and believe it to have been not rare in that jungle.

223. H49-72. **Amblypodia diardi** Hew.

I took two in bamboo jungle at an elevation of nearly 2,000 feet in the Mayu Range in October.

224. H55-1. **Drina donina** Hew.

Two at Cheringa in March.

225. H59-1♂. **Pratapa vidura penicilligera** DeN.

Fairly common in thick jungle throughout the area, in February–March, and again in August.

226. H60-19β. **Tajuria cippus cippus** F.

I took a single specimen at Razabil (Mayu Peninsula) in November.

227. H75γ. **Thamala marciana sparanisa** Fruh.

I took two males of this handsome butterfly on the crest of the Mayu Range in October. Since the races are differentiated by the ♀, I do not know to which I should refer my specimens.

228. H77-1β. **Horaga onyx onyx** M.

Rare. I took it at Teknaf in May, and at Myebon in January and February.

229. H84-2β. **Virachola perse perse** Hew.

A single ♀ at Ru-ywa in March.

230. H85-7♂. **Rapala suffusa suffusa** M.

Rare. I took three at Myebon in January and February, where they were flying with *pheretimus*, *dieneces* and *jarbas*, all of which were common.

231. H85-11γ. **Rapala varuna orseis** Hew.

Found only at Ru-ywa in March.

232. H85-12. **Rapala schistacea** M.

Not rare at a locality on the Mayu Range in December.

HESPERIIDAE

233. I 1-13♂. **Hasora vitta indica** Evans.

One at Ru-ywa in March.

234. I 3♂. **Bibasis sena sena** M.

One on the Mayu Range in October.

235. I 6-2β. **Orthopaetus phanaeus fulva** Evans.

One at Cheringa, March.

236. I 11-13. **Celaenorrhinus plagifera** DeN.

Mayu Range, October and November.

237. I 11-21♂. **Celaenorrhinus asmara concertus** DeN.

One at Cheringa, March.

238. I 14-10γ. **Tagiades litigiosa ultra** Evans.

Not rare in the Mayu Peninsula from August to November.

239. I 19-6♂. **Daimio bhagava bhagava** M.

Widely distributed but not common. March and November.

240. I 20-1γ. **Coladenia dan dhyana** Fruh.

Two at Ru-ywa in March.

241. I 20-2β. **Coladenia indrani indra** Evans.

Two at Chittagong and one at Ru-ywa, all in March. I cannot yet say whether any of these specimens should be referred to *uposathra* Fruh.

242. I 47-1β. **Suastus gremius gremius** F.

Myebon in January and February. Not common.

243. I 49♂. **Suada swerga swerga** DeN.

It was not rare at Cheringa in March.

244. I 50-2♂. **Koruthaialos butleri butleri** WM.

I took one in evergreen jungle at Myebon in February. It was flying with *Sancus pulligo subfasciatus*. M. which it somewhat resembles, and may for that reason be more common than a single capture suggests.

245. I 55-1. **Kerana nigrita** God.

Not rare in the foothills of the Mayu Range in October and November and at Myebon in February.

246. I 58-4β. **Notocrypta paralysos clavata** Stg.

Two at Maungdaw in August, and one at Myebon in February.

247. I 58-6. **Notocrypta curvifascia** Fd.

Cheringa, Maungdaw and Ru-ywa : March and November ; not common.

248. I 64-4. **Matapa sasivarna** M.

I took this in March at Chering, where I believe it to have been not rare, and at Myebon in the following February.

249. I 64-5. **Matapa shalgrama** M.

One in the Ngakyedauk Pass in November.

250. I 66-1β. **Hyarotis adrastus praba** M.

Not rare in the coastal plain around Maungdaw, from August to September.

251. I 68-3♂. **Zographetus ogygia ogygia** Hew.

Not rare at Myebon in late February and March.

252. I 83-29♂. **Halpe zema zema** Hew.

One from the Mayu Range; October.

253. I 83-31♂. **Halpe moorei moorei** Watson.

Rare. I took it at Myebon in February.

254. I 83-34♂. **Halpe homolea aucma** Swin.

Possibly not rare. I took it in the Mayu Range in October and at Ru-ywa in March.

255. I 87♂. **Cupitha purreea purreea** M.

Rare. I took it in thick jungle at Myebon and Ru-ywa in February and March.

256. I 88-2γ. **Taractrocera maevius lineata** Druce.

I am practically certain I saw a pair of this species in Akyab Island in March, but I could not secure them. I know *maevius* well in South India.

257. I 89-3β. **Oriens gola gola** M.

I took it at Cheringa and Myebon, where it was not rare, in February and March.

258. I 90-9β. **Padraona cato clio** Evans.

Not rare at Chittagong, in the Mayu Range and at Myebon, but only noted in the months from December to February. I have examined the genitalia and am reasonably certain that all my *Padraonae* belong to the species named *cato* in Evans's Identification.

259. I 92-3♂. **Cephrenes palmarum palmarum** M.

One at Razabil (Mayu foothills) in November.

260. I 96-1β. **Iton semamora barea** Hew.

Not rare at Cheringa in March.

261. I 97-1β. **Baoris oceia farri** M.

Teknaf and Ru-ywa in October and March.

262. I 97-2. **Baoris brunnea** Snell.

A single ♂ from Cheringa in March.

263. I 97-7γ. **Baoris cahira carna** Evans.

Not rare at Cheringa, Akyab, Myebon and Ru-ywa in February and March.

264. I 97-10♂. **Baoris cormasa moolata** M.

Akyab Island and Myebon in February and March.

265. I 97-20. **Baoris contigua** Mab.

Two at Chittagong, February and March.

266. I 97-23. **Baoris assamensis** WM & DeN.

Not rare in the Mayu Peninsula in October, and from December to March.

267. I 97-30♂. **Baoris sinensis subochracea** M.

Common in the coastal plain at Maungdaw from July to November.

268. I 97-31β. **Baoris mathias mathias** F.

Common in the coastal plain in August, and again in February and March.

269. I 97-32β. **Baoris guttatus bada** M.

Common in the coastal plain from August to November, and from January to March.

270. I 97-34β. **Baoris bevani bevani** M.

Though I am not quite certain of my identification, I think I have specimens of *bevani* from Chittagong in March, and from Maungdaw in September.

I have one or two more *Baoris* which I have not been able to identify.

Analysis

Number of species and forms, excluding seasonal forms, known to occur in the area :—

Family	In Major Gladman's List	Additional species in present list	Total
Papilionidae	15	5	20
Pieridae	21	3	24
Danaidae	15	4	19
Satyridae	9	12	21
Amathusiidae	1	2	3
Nymphalidae	35	13	48
Erycinidae	2	1	3
Lycaenidae	40	33	73
Hesperiidae	21	38	59
Total ...	159	111	270

SOME SUGGESTIONS FOR ENTOMOLOGICAL WORK IN INDIA

BY

D. G. SEVASTOPULO, F.R.E.S.

Sooner or later a collector of insects realises that entomology is something more than the accumulation of boxes of specimens, and then, unless his interest can be stimulated and guided, he is likely to become dissatisfied with his hobby and eventually to drop it altogether. In Europe and America, with their wealth of entomological periodicals and societies, the latter often with large libraries and holding frequent meetings, enabling the student to learn something of past work and current progress, this guidance and stimulation is a comparatively easy matter. In India it is otherwise, and in this paper I propose to try to suggest lines of work that I consider of interest to amateurs with only limited time at their disposal.

Entomology is the science of insects, and it cannot be too much stressed that insects are living creatures and not rows of corpses in boxes. The professional entomologist's bias towards statistical papers and descriptions of aphides seta by seta, necessary as they may be, tends to dull the enthusiasm of the amateur, whose interests more often lie in the pure, rather than in the applied, side of his science. There are numerous problems, many of them of no immediate practical value, that are better suited to the activities of the amateur, rather than the professional entomologist; many of them are problems of great scientific interest, and the answers to others may fit into the jigsaw of knowledge that we already possess and produce a finished picture that may have great practical value.

I would urge all entomologists to keep careful notes and records and to work them up into papers for publication. I believe that this is one of the best means of maintaining interest and adding to the worker's knowledge, not to mention the addition to the general store of entomological learning. Notes, however carefully made, are of little value if they are only to be seen by the compiler and, eventually, to be treated as rubbish by his executors. Editors can, generally speaking, be relied on to use their blue pencil on useless communications, and it is surprising how many facts, which seem well-known and commonplace to some small circle of experts, are really unknown and of the greatest interest to the far larger circle of general workers.

Being a lepidopterist, the following notes deal mainly with problems concerning butterflies and moths, but much of what I write has, I think, a more general application, and students of other orders will, I hope, be able to think of parallel problems which concern the insects that are their chief interest. I have avoided any problems that require either technical knowledge or compli-

cated apparatus, and I have assumed that readers are acquainted with the methods of rearing insects through their early stages.

Distribution.—Our knowledge of the distribution of Indian insects in general is appallingly low; we may know a little about the butterflies, considerably less about the moths, and next to nothing about the other orders. I would, therefore, suggest that all collectors of all orders keep careful records and publish periodical lists of the fauna of the districts in which they collect, irrespective of whether they are permanent residents or mere visitors for a month or so. It is from such lists that it is possible to build up an all-over picture of the distribution of a species, and, if the accumulation of lists covers a sufficient period, to determine when and where changes in distribution have taken place. Beirne has recently published (1947, *Trans. R. ent. Soc. Lond.*, 98, 273-372) a most interesting paper on the history and origins of the British macro-lepidoptera based on distribution and other data. Do not imagine that even the best known localities are properly worked out. On a recent visit to Tukdah, near Darjeeling, I discovered two Zygaenids and a *Leucoma* new to science, a Lycaenid previously unknown west of the Khasia Hills, and have a number of undetermined Noctuids, Geometers and Pyralids, which will almost certainly include some new species. In Calcutta I recently discovered two new *Redoa* spp., both common species that I only found were undescribed when I sent bred specimens to the British Museum for confirmation of my identifications before publishing descriptions of the larvae in this *Journal*. The publication of a list recording the results of even a week's collecting may provide the essential link to complete the record of some migration. In entomology, as in all science, no fact, provided it is correct, is too small to be worth recording; it is only through the accumulation of many, often apparently unrelated, facts that the whole design is revealed. Finally I would make a plea for accuracy. If later knowledge shows that a species has been wrongly identified, a correction must always be made.

The Existence of a Diapause.—The majority of Indian species are continuously-brooded, but there are a few that appear to have a well-defined time of emergence. Careful recording of the occurrence of each species, month by month, will determine whether an insect is continuously-brooded or not. Breeding experiments will probably be necessary to determine whether there is a diapause, or whether the break between broods is due to slow development in the early stages. In Britain the diapause usually takes the form of hibernation to tide over the period of cold; in fact it is often the lack of this period of inactivity that prevents insects with more southern origins from establishing themselves, and it may be passed in any one of the four stages which make up the insect life cycle. In hot countries the diapause usually occurs in the hot season to escape heat and dryness. In Calcutta, for example, *Papilio crino* F., *Graphium nomius* Esp., *Neptis hylas* L. and *N. jumbah* Moore all appear to have an emergence at the end of the cold weather in Feb./March and the imago is only seen at this time.

Seasonal Forms.—By now most of the seasonal forms occurring in India have been connected up, although it is suggested that

Catopsilia pyranthe L. and *C. florella* F. are the wet and dry forms respectively of the single species *C. pyranthe*. We do not, however, know the exact causes of seasonal dimorphism. In Britain it is usually connected with the longer development period of the brood appearing in the spring. In tropical countries it appears to be due to changes in humidity. Various suggestions have been put forward; it has been suggested that the actual cause is the type of food, new and lush or old and dry, eaten by the larva, or that it is the direct result of high humidity or aridity acting on the larva and/or the pupa, or even that it is constitutional and that, after a certain number of generations of the one form, the other will appear, irrespective of conditions. I have experimented with species belonging to two Satyrid genera—*Mycalesis* and *Ypthima* —varying the maturity of the grass fed to different batches of larvae from ova laid by one female, and rearing part broods under conditions of very high and very low humidity respectively, but without any really conclusive results—wet, dry and intermediate forms appearing in each type of culture. Pryer is reported to have produced the two extreme forms of *Eurema* (*Terias*) *hecabe* L. in Japan by subjecting the pupa to heat and cold (*Seitz's Indo-Austr. Rhopalocera,* ix, 167). It is obvious that there is plenty of scope for ingenuity in devising experiments on this problem. The phenomenon of seasonal dimorphism must not, of course, be confused with the results obtained by exposing larvae and pupae to temperatures which they would never experience in a state of nature. I know of no recorded instances of seasonal dimorphism in the early stages, but I have larvae of *Ergolis merione* Cr. found in March with very much shorter branched spines than those found in July.

Temperature Experiments.—If the larvae and pupae of many species of lepidoptera are exposed to abnormally high or low temperatures, forms differing widely from the normal are produced. The patterns on the wings of lepidoptera are produced by the successive flooding of the wings with the various pigments, often at an early stage in their formation, and these can only be taken up by scales at a particular stage in their development. The effect of extreme heat or cold upsets this synchronisation and results in abnormal patterns. Pupae are said not to be sensitive to the effects of temperature after they have been formed twenty-four hours. In India, with the widespread use of domestic refrigerators, entomologists have every facility for testing the effects of extreme cold. For testing the effect of heat it is possible to devise a small incubator by fitting a small box into a larger and packing the surrounding interspaces with wadding and this may be heated by one or more electric light bulbs. I know of no records of experiments of this nature carried out in India, but in Europe it has been found that cold increases the deposit of the black pigment melanin in the Vanessidi and decreases it in the Pieridae, whilst heat has the opposite effect. Anyone carrying out experiments of this nature should keep careful notes of the temperatures employed, the length of the period of exposure, the stages subjected to the abnormal conditions and the variation in the time of development as compared with controls under normal conditions. It may be mentioned that working on the English *Aglais urticae* L., cold produced forms

that have never been met with in nature but that heat produced a form very similar to the Corsican race of the species.

The Use of the Secondary Sexual Apparatus.—A very large number of Indian butterflies and moths possess secondary sexual apparatus in the form of specialised scales covering patches of a glandular nature and these scales are often in contact with tufts of specialised hair. It is known that the glandular tissue produces a scent, which diffuses through the specialised scales and is distributed by the tufts of hair, which may exist on the wings, body or limbs of the insect, and it is thought that their special function is to stimulate the female at the time of pairing. So far as I know there are only three published records of the use of these brushes in courtship—two by Prof. Hale Carpenter concerning African Danaids and one by myself concerning *Euploea core* Cr. There are no records known to me of the use of the folds filled with fine hairs on the inner margin of the hind wings of many male Papilionids, nor of the hair tufts on the wings of *Catopsilia, Mycalesis, Pratapa* and *Rapala,* to name only a few butterfly genera. This is not an easy subject for investigation; in butterflies it may mean many hours of observation in the open where the species happens to be abundant, although it may also, as in the three recorded instances, be the result of quite a casual encounter. It is unlikely that the sexual display of moths will ever be observed in a state of nature, although it may be possible to watch it in captivity if the insects are kept in fairly large cages. There is always the possibility that light prevents displaying, in which case, of course, it would never be seen.

I am not suggesting an examination of the structure of these organs as this entails the use of a considerable amount of apparatus and the possession of considerable skill in the cutting of sections and the mounting of microscopical slides. The late Dr. Eltringham did a great deal of work of this nature and published numerous papers in the *Transactions of the Royal Entomological Society* and elsewhere.

Scents of Lepidoptera.—The late Dr. Longstaff investigated the scents of butterflies on a considerable scale, but much still remains to be done. Moths have been neglected, although the males of many species emit quite a perceptible scent. This is an interesting subject for anyone with a keen sense of smell, but it is difficult in many cases to describe the scents perceived. Generally speaking, scents which are confined to the male sex are pleasant, reminiscent of flower or vegetable perfumes, whilst those that are common to both sexes or confined to the female are unpleasant and of a more animal nature. To take a few Indian examples, the males of *Cepora* (*Huphina*) *nerissa* F. have a scent like sweet-briar, those of *Elymnias hypermnestra* L. of vanilla-scented chocolate, and of *Mycalesis mineus* L. like brown sugar.

Shock-produced Intersexes.—Some twenty or so years ago, a number of intersexes of the African *Papilio dardanus* Brown were exhibited at a meeting of the Entomological Society of London. These intersexes, it was claimed, had resulted from subjecting the newly formed pupae to severe shock and vibration. Geneticists have all denied the possibility of intersexes arising from this cause,

and, so far as I know, these experiments have never been repeated by anyone with positive results. Two Indian species would seem to be very suitable subjects for experiment—*Papilio polytes* L. and *P. memnon* L. The method used for applying the shock was to force the larva to pupate on the side of a box and then to give the box several sharp taps with a hammer or mallet at the time the change to the pupa was taking place. Care has to be taken not to strike too hard, as the newly formed and tender pupa may be so badly bruised that it dies, or it may slip out of its girdle and fall. Results of any experiments, whether positive or negative, would be of the greatest interest.

Palatability of Insects.—This is an extremely interesting subject, both for straightforward field work as well as for experiment both indoors and out. Careful records should be made of any attacks on insects by birds and lizards, with notes of whether the insect is actually consumed, discarded or escapes. In the house, the attacks of geckos on insects attracted by light are always interesting. The whole subject is, of course, bound up with the theory of mimicry, both Batesian and Mullerian. Experimentally, much work can be done with cage birds and small insectivorous mammals, as well as with lizards. Insects of various species should be offered in combination and careful notes made of the reception of each species, the state of hunger of the predator and any other relevant details. Experiments under more natural conditions may be made by putting down insects on lawns or open ground where mynahs and other birds are feeding, keeping a note of the order in which the various species are eaten and of what species are left untouched. A very interesting set of experiments was once carried out with ants, the insects to be tested being mashed up with cream and the mixture smeared on slips of glass and exposed to the attacks of ants. A control slip of pure cream was included and, after a short period to allow the ants to find the slips and start feeding, counts were made of the number of ants at each slip. In addition to the tests made with insects, a second series was done with various larval food-plants. When experimenting with larvae it would be interesting to test larvae straight off the food-plant against larvae starved for twenty-four hours, so that the intestines would be empty, and also with their frass extracted with cream. This would show whether distastefulness was due to the larva itself or to the food contained in the intestines.

Colour Perception.—It has been noticed that many species of butterfly are more attracted to flowers of one colour than to those of another and it has been suggested that the more attractive colours are very often those colours that are found in the wings of the species in question. Other investigators claim to have found the exact opposite; the genus *Pieris*, for example, is said to be attracted most to reds and purples and the Vanessidi to yellows and violets. Attraction by the colour of flowers is, of course, complicated by the presence of scents. It may be that the extra attraction of one flower over another is more a question of scent than of colour.

A very interesting series of experiments was carried out with the English *Argynnis euphrosyne* L., an insect not unlike our *Atella phalanta* Drury. Paper models, made by cutting out photographs

and painting the ground colour in different colours, and actual dead specimens, bleached and dyed (in all cases the black spots were repainted so that the pattern was unaltered but the ground colour changed) were exposed in a wood where the species was plentiful and records were kept of the numbers of wild butterflies that paused to examine them. It was found that the greatest number of visits were paid to untreated specimens, models and actual specimens dyed a colour close to the natural tawny were visited less frequently and those dyed in unnatural colours were ignored altogether. Among the models and specimens exposed were some with the ground colour white, not unlike a rare albino variety of the species, and these were also completely ignored, indicating that an albino female would probably never have an opportunity of mating.

Are *Catopsilia crocale* Cr. and *C. pomona* F. conspecific?—Although most of the books on Indian butterflies treat these two insects as distinct species, there is a very large body of entomologists who consider they are one. The early stages and the genitalia appear to be indistinguishable, intermediate specimens have often been found as well as mated pairs in which one member was *pomona* and the other *crocale*. There are, however, no published records of bred families to prove the question one way or the other, although I believe Mr. T. R. Bell of Karwar has actually reared broods from all possible combinations and is convinced that both are forms of one species. This is an interesting line of work, and the Prince of Wales Museum in Bombay, the British Museum (Natural History) in London and the Hope Department at Oxford would all be very glad to receive complete bred families with the parents if these threw any light on the question. Needless to add, all results should be published.

Parasites.—Much work is to be done on the parasites, both dipterous and hymenopterous, of Indian insects; many species are undescribed and many of those that are known have no records of their host species. Anybody breeding out parasites from his usual material should preserve them carefully, with full data of the host larva and of their own biology, whether they pupate internally or externally, whether the host larva succeeds in spinning or pupating or whether it dies in an early instar. A note of the instar in which the larva was when found is also interesting as it gives a clue to the stage in which parasitization takes place. It is best to preserve the whole brood of the parasites, together with their cocoons *in situ*. In many species males are very rare, sometimes they have not been found at all, and in others a rare phenomenon known as polyembryony occurs, the female lays one egg in the host and this, instead of producing one larva, produces a large number, which are, of course, all of the same sex. This is commonest in egg parasites.

The Society would, I am sure, be prepared to send specimens to recognised experts in this group.

Relations with Ants.—Whilst a number of Indian Lycaenids are attended by ants in the larval stage, and whilst we have a number of Lycaenid genera that are purely carnivorous, such as *Gerydus* feeding on aphides, *Spalgis* on coccids and *Liphyra* on ants, there are no Indian species that I know which must have the attention

of ants if the larvae are to survive, or which have the very interesting and complicated life-history of the English *Maculinea arion* L. As is probably generally known, many Lycaenid larvae possess glands on the 10th and 11th somites, the gland on the 10th somite is dorsal in position and secretes a sweet, honey-like substance. The glands on the 11th somite are sub-spiracular and their function is still unknown. The honey from the gland on the 10th somite is very attractive to ants, and most Lycaenid larvae will be found to be attended by several ants, which stroke and caress it, and then suck up the droplet of honey that the gland excretes. This arrangement is obviously to the benefit of both insects, the ant obtaining refreshment and the Lycaenid larva protection, but in certain African species things have gone so far that the Lycaenid larva is unable to survive if deprived of the ants' attentions, the honey-gland becoming choked with mould, causing the owner's death. I know of no Indian Lycaenid so constituted, but it is possible that such species do exist and it would be interesting to discover if they could be kept in good health without ants by cleaning the honey-gland with a fine paint brush. The English *M. arion*, referred to above, has a larva which, for its first three instars, feeds on thyme in the usual way. After its third moult, however, it leaves its food-plant and proceeds to wander until it meets an ant; the ant is attracted to the honey and the Lycaenid larva then adopts a special posture and the ant straddles it, picks it up and carries it down to its nest, where it lives feeding (except for a period of hybernation) on the ant larvae until pupation, which takes place in the nest. In addition to the Lycaenidae, many Pierid larvae in their early instars possess forked hairs which hold droplets of liquid attractive to ants. This is a far less specialised arrangement than that exhibited by the Lycaenidae, and one which does not persist in the later instars, unlike the Lycaenids where the gland is often undeveloped until the third instar.

In addition to the special points referred to above, it would be interesting to know whether special species of ants attend special species of Lycaenid larvae, and whether all species of ants realise the possibility of obtaining refreshment of this nature.

Genetics.—Here we have a most interesting subject to investigate and, due to the rapidity with which brood succeeds brood in India, work that might take four or five years at least in a temperate climate can be completed in six months or so. Our knowledge of the genetics of Indian insects is meagre, to say the least; so far as I can recall, only the three female forms of *Papilio polytes* L. and some of the forms of *P. memnon* L. have been worked out.

Although this is, in the main, a practical paper, some knowledge of the modern theory of genetics is necessary to understand what we are trying to investigate. Broadly speaking the modern science of genetics dates from Mendel's discovery that when two varieties of an organism are crossed the characteristics do not blend and lose their identity but continue unchanged in their descendants. In other words crossing a red and a yellow variety of an insect or flower does not produce an orange variety which will breed true, there are special cases where an orange variety will be produced but this will not breed true, and normally the offspring of the

red × yellow crossing will all be red or all be yellow, and the following generation will be both red and yellow in definite proportions. We now know that the characteristics of an organism are controlled by what are called genes, these work in pairs, one member being derived from each parent, and each pair controls one particular characteristic, maybe the ground colour, the pattern, or some particular part thereof, size, etc., etc. The foregoing is really an oversimplification; in many cases a pair of genes control more than one characteristic, for instance a single pair determines the tailed form *achetes* Sulz. and the tailless *isarcha* Seitz, with its different pattern, of *Papilio memnon* L., and presumably a single gene controls both the black and the white apex of the forewing of *Hypolimnas misippus* L., the absence of which results in *f. inaria* Cr. The two members of a pair of genes are referred to as allelomorphs and, normally, one of the pair is stronger than the other and masks its effect. When both are present the stronger member of the pair is referred to as the dominant and the weaker as the recessive. Let us now assume that a butterfly exists in two forms, a typical red and a rare yellow variety and that the red is dominant to the yellow. An insect containing two dominant genes will be red in colour and is known as a homozygous dominant, one with two yellow will be yellow and is known as a homozygous recessive whilst one that contains a red and a yellow gene will be red (since red is dominant to yellow) and is known as a heterozygote. In some rare cases the heterozygotes are intermediate in appearance between the dominant and the recessive homozygotes.

When writing about the genetics of any particular species, it is usual to employ the initial letter of the characterstic of the variety as a capital to indicate the dominant and as a small letter to indicate the recessive of a pair of allelomorphs. In our imaginary example, the red gene would be written 'Y' and the yellow 'y'. Each cell of every individual contains two members of each pair of allelomorphs, either two dominants, two recessives, or one of each, but at the time of the formation of the reproductive cells, the sperm and the ovum, they split so that each ovum or sperm contains one only of the allelomorphic pair. When the ovum and sperm conjugate at the time of fertilisation, the paired character is restored, one gene of each pair coming from each parent. Whilst we have only been considering one allelomorphic pair, it must not be forgotten that each cell carries a vast number of such pairs, all behaving in exactly the same way, and that an individual may be a homozygous dominant in respect to certain genes, a homozygous recessive in respect to others and a heterozygote in respect of still others.

Normally a typical individual of a species is a combination of homozygous dominant and heterozygous pairs of allelomorphs, and varieties are recessive for the particular form of variation they exhibit. There are, however, cases where the variety is dominant to the type, and it is generally thought that in such cases the variety is either exposed to far greater dangers than the type, so that its chances of survival are very small, or that the gene in its homozygous form carries a lethal, weakening or sterile factor, and that individuals exhibiting this particular form of variation are really

heterozygotes in constitution, the homozygous dominants being either non-existent or exceedingly rare. The dark variety *valezina* Esp. of the European *Argynnis paphia* L. is an example of this. If something of this sort were not the case, it is obvious that the dominant variety would gradually increase and eventually replace the type completely. This has actually happened in recent years in a number of species of British moths, where a phenomenon named Industrial Melanism has arisen. In these species, which are normally procryptic, bark- or rock-resting species with a mottled grey and brown colouring, a black mutant has appeared and has, in a comparatively short space of time, completely supplanted the type in many districts. It has been suggested that these black mutants are not only stronger in constitution, but that they are better favoured by natural selection, the industrialisation of the districts which they inhabit has resulted in their natural resting sites being blackened by soot so that the species' normal type of colour is no longer concealing.

The occurrence of a homozygous recessive in nature is normally a rare thing, much more so than is the occurrence of one individual that combines two recessive homozygous genes. For instance, let us assume that our hypothetical red butterfly is normally spotted with black and that, in addition to the rare black-spotted, yellow variety, it also produces a rare, red, unspotted form. In nature the odds against finding an unspotted, yellow specimen are enormous, but by breeding from two pure lines, one yellow and spotted and the other unspotted and red, we can obtain a combination of the two pairs of allelomorphs, as will be described below. In some cases such a combination of two pairs of allelomorphs will produce an individual showing the variation of both parents, in other cases it will be something entirely new and differing widely from its parents.

In genetical work the first bred generation is referred to as the first filial generation (F1), their offspring as the second filial generation (F 2) and so on. The original parents are said to belong to the first parental generation (P1).

Let us now see what will happen when we cross a homozygous dominant and a homozygous recessive of our imaginary red butterfly. The constitution of the red homozygote, the dominant, will be YY, that of the yellow, the homozygous recessive, will be yy. In the reproductive cells these pairs will have split and all the sperms will be carrying a Y and the ova a y, assuming that the male is the red and the female the yellow example. On fertilisation they will recombine, but the pairs will now all consist of a Y and a y. If a pairing is made between two members of the F1 generation, each sperm and each ovum will carry either a Y or a y, and, on fertilisation, the recombination pairs may be YY, yy or Yy. Let us show this diagrammatically upto the F 2 generation.

In other words when two homozygotes are crossed all the offspring are heterozygous and when these are crossed *inter se* we obtain a ratio of 1 homozygous dominant: 2 heterozygotes: 1 homozygous recessive, or in appearance, owing to the heterozygote being similar to the dominant homozygote, a ratio of 3 red: 1 yellow.

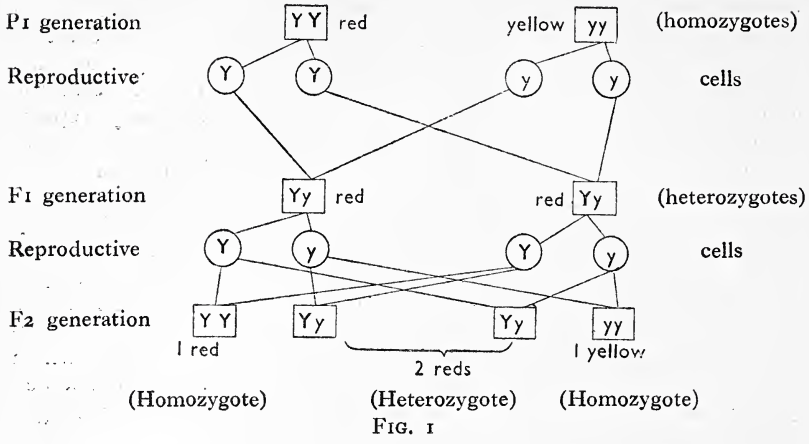


FIG. 1

The mating between a homozygote and a heterozygote is known as a back-cross and the following diagram shews the result of a mating in which the homozygote is the recessive.

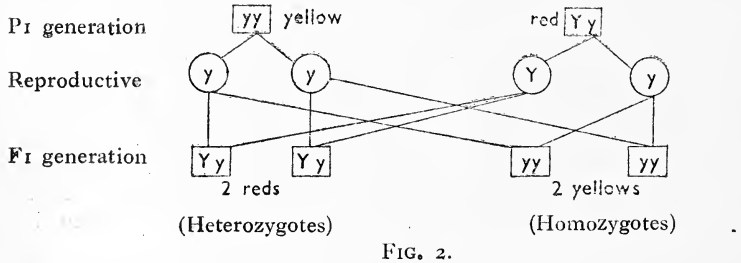


FIG. 2.

If the mating is between a homozygous dominant and a heterozygote, we again obtain a ratio of 2 homozygotes : 2 heterozygotes, but in appearance all four insects will be alike.

In all cases where there is a variety due to a single pair of allelomorphs, therefore, we may expect our breeding results to be in one of three ratios—3 : 1, 2 : 2, or 4 : 0—depending on the constitution of the parents. In cases where the dominant homozygote is so weak that it cannot survive, the 3 : 1 ratio will become 2 : 1 owing to the elimination of the homozygous dominants. The difference between a 3 : 1 and a 2 : 1 ratio is not statistically significant in broods of less than 56 individuals, so that it is important, when undertaking work of this nature, to rear as large broods as possible. I do not propose to go into the question of statistical significance here.

Let us now consider the results of crossing a spotless red and a spotted yellow variety of our hypothetical species. Let us call the gene responsible for the spotless form o (the recessive) and the spotted O (the dominant), o being the initial letter of obsolete the usual term for spotlessness. Our spotless red individual will be carrying the allelomorphic pair of genes oo for the spotless con-

dition and YY for the red, the spotted yellow OO and yy for the corresponding two characteristics, and these may be written as ooYY and OOyy respectively. In the F1 generation we get nothing but double heterozygotes with the constitution OYoy. In the F2 generation we get fresh combinations, the actual ratios being 1 YYOO:1 YYoo:2 YyOO:2 YYOo:4 YyOo:2 yyOo: 2 Yyoo:1 yyOO:1 yyoo, in which all individuals with the constitution YYOO, YyOO, YYOo, YyOo will be normal red and spotted individuals, those with the constitution yyOo and yyOO yellow and spotted, YYoo and Yyoo red and unspotted, whilst those that are yyoo will be both yellow and unspotted. In appearance there will be 9 normals: 3 unspotted reds: 3 spotted yellows: 1 unspotted yellow. I do not propose to show how these come about diagrammatically, but readers may be interested enough to work them out, it being remembered that the germ cells will have the constitution YO, Yo, yO and yo.

We now come to rather more complicated aspects of the subject. Every cell in the body of an organism contains what are known as chromosomes, which, at the time of cell division, can be detected under a microscope if suitably stained. These chromosomes are present in pairs and the two members of a pair are said to be homologous. One member of each homologous pair is derived from each parent and it is now known that the chromosomes are the actual carriers of the genes. If two genes are carried by the same chromosome they are said to be linked and it would be impossible to obtain some of the combinations similar to those obtained in the hypothetical spotless red and spotted yellow pairing. Sex is itself of a genetic nature, the males in lepidoptera having two X chromosomes and females an X and a Y. Normally the X chromosomes bear certain genes in addition to those for sex, but the Y chromosome is practically functionless and does not carry the normal allelomorphs for the genes carried by the X chromosome. A character that is carried by the X chromosome is said to be sex-linked and, if recessive, would be far rarer in the male than in the female—in the male the insect would have to be homozygous whilst in the female the Y chromosome would have no effect of masking it. If a certain pairing produces an all over 3:1 ratio but all the males are typical and the females half typical and half mutant, it is likely that we are dealing with a sex-linked factor, which can be confirmed by mating the mutant females with their brothers in the hope that one will be a heterozygote, the result of which would be male and female types and mutants in equal numbers. This is entirely different from sex-controlled characters, for which the genes are carried by the autosomes in both sexes, but which can only manifest themselves in one sex and this again is an entirely different phenomenon from that in which a sexually dimorphic species has a variant of one sex that cannot, for physical reasons, appear in the other. For instance the female f. *catilla* Cr. of *Catopsilia pomona* F. is sex-controlled, there is no apparent reason why the purple blotches on the underside of the hind-wing should be confined to the female sex; the female f. *inaria* Cr., of *Hypolimnas misippus* L. is not, however, as the male has no black and white apex to lose.

We now come to another interesting phenomenon known as multiple allelomorphism. Normally allelomorphs exist producing two phases only of a character, but there are cases where three, four, or even more forms of the same gene exist. These can be arranged in a series in which the first is dominant to all the others, but these others give intermediate results when crossed among themselves. Taking our hypothetical red butterfly, such a series might be red, orange, yellow and white in colour, with the red dominant to the other three. A cross between a yellow and an orange would produce all pale orange offspring, as neither form would be dominant to the other, and these pale orange examples crossed *inter se* would segregate out in the ratio 1 yellow:2 pale orange:1 orange. If the orange and yellow forms did not belong to the same allelomorphic series, the F1 generation would all be normal reds in the same way that the cross between the unspotted red and spotted yellow variety produced all normal, spotted, red offspring.

The last phenomenon we will consider before passing on to the practical application of this section is multifactorial inheritance. In this a character is controlled not by one but by a number of genes, all of approximately equal importance. In such a case the normal form will be the common one because it will be dominant, and departures from it will become progressively rarer the more extreme they become. When such an insect pairs with a normal the offspring do not segregate in any specific proportion, but include typical insects, the variants, intermediates and various mixtures between them. I can think of no Indian species that may exhibit this type of inheritance. In England it is known among the Satyridae, species normally bearing one ocellus having varieties with two or more ocelli, and, conversely, species normally with a number of ocelli having varieties where they are reduced both in size and number. In the Polyommatini multifactorial inheritance is thought to be the cause of underside variation in which the normal spotting may be much reduced or completely obsolete on the one hand and be present as rays and lines on the other.

Turning to the practical side, let us assume that we have captured a female variety of some insect and are anxious to work out its genetics. If the insect is not obviously freshly emerged, the chances are that it will have mated and, in all probability, with a normal male. If our female is freshly emerged we must endeavour to provide her with a mate, probably not too difficult a task if the species is a common one. If the variety is a male we have the almost impossible task of providing a virgin female with which to pair him. We then endeavour to induce our female to lay as many ova as possible and the resulting larvae are all reared to maturity, keeping a careful note of the number of ova that fail to hatch, the number of deaths in the various larval instars and in the pupal state and the proportion of various forms in the resulting imagines. Having obtained our F1 generation, we now have a certain amount of data to help in determining the probable genetic constitution of the parents. Normally all the F1 generation will be normals and it is an indication that the pairing was between a normal, dominant male and a mutant, recessive female, all the offspring being heterozygous in constitution. A pairing should result in a 3 normal: 1 variety

ratio in the F2 generation. Let us examine the other possibilities. Assuming that our variety is a recessive, its mate may also have been a recessive, in which case the F1 generation would all have been the same as the female parent and would have bred true in the F2 generation, an out-cross with a normal would produce nothing but normals in the F1 generation and these would segregate 3: 1 in the F2 generation. The third alternative is that the unknown mate was a heterozygote, in other words a natural back-cross, and this would separate in equality in the F1 generation, whilst in the F2 generation a pairing from F1 types would separate out in the 3: 1 ratio and of F1 varieties would breed true. Assuming that our variety was a dominant homozygote, its mate might have been a recessive normal, in which case the F1 generation would all be like the female parent and the F2 generation would segregate in a ratio of 3 varieties: 1 normal. Or it might be a heterozygote, in which case, again, the F1 generation would all be the variety and the F2 generation would either produce 3 varieties: 1 normal or all varieties depending on the type of pairing. The third possible mate would have been a dominant similar to itself, in which case, again, all the offspring in the F1 generation would have been varieties, which would breed true in the F 2. Here again an out-cross with a normal would clear up the position. The two other alternatives for the variety are either a heterozygote, in which dominance is complete, or a heterozygote where it is not. There is also the other possibility of the variety being an environmental or temperature form, in which case, of course, it is difficult to forecast what the F1 generation would consist of. The reader will be able to work out the theoretical ratios for the different pairings where the female variety was a heterozygote. The importance of keeping careful records of failures to hatch and of mortality will be realised if a brood produces a 2: 1 ratio and some 25% of the ova fail to produce imagines, this would indicate some lethal factor that prevents the development of the homozygous dominants and that all the varieties were heterozygotes.

For anyone interested in this subject, I would very strongly recommend a study of the book entitled *British Butterflies* by E. B. Ford, in the New Naturalist Series published by Collins of London. This gives a very great deal of information both on the theoretical and practical side of genetical work.

Let us now see what insects we have in India suitable for investigation. First let us take some of the named varieties. Among the Papillionidae there are *Polydorus aristolochiae* F. and its variety *diphilus* Esp.; the *Euploea-* and *Danais*-like forms of *Chilasa clytia* L.; the many forms of *Papilio memnon* L.; the three female forms of *P. polytes* L.; and *P. crino* F. and its male variety *montanus* Feld. Among the commoner Pierids there are the various female forms of *Ixias pyrene* L.; *Catopsilia crocale* Cr. in its yellow and yellow-and-white forms; *C. pomona* F. with its female forms *catilla* Cr., *bidotata* Fruhs. *nivescens* Fruhs. and *siscia* Fruhs.; and *Valeria valeria* Cr. and its female form *philomela* F. In the Danaidae there is *Danaus chrysippus* L. with its forms *alcippus* Cr., *dorippus* Klug, *bowringi* Moore and *amplifascia* Talbot. Among the Satyridae I can only think of one example, *Orsotriaena medus* F.

in which the difference between the two dry season forms *runeka* Moore and *turbata* Fruhs. may be genetic in origin, although it is usually ascribed to climatic differences. The extreme variation exhibited on the underside of the dry season forms of *Mycalesis* and *Melanitis* is probably multifactorial and influenced by environmental factors and is unlikely ever to be worked out. Among the commoner Nymphalidae there is *Hypolimnas misippus* L. with its two female varieties *inaria* Cr. and *alcippoides* Btlr. I can think of no named varieties among the remaining three butterfly families, but the Lycaenidae produces a number of underside varieties, where the spots are either reduced or wanting, or lengthened into streaks. In the Heterocera we have numerous subjects for experiment; among the Arctiids there are a number of red-bodied or red-marked species with a yellow mutant—*Pericallia ricini* F. and ab. *zerah* Cr., *Diacrisia casigneta* Koll. and ab. *xanthogaster* Roths. and *D. obliqua* Wlk. and ab. *dalbergiae* Moore for example—and among the *Diacrisia* species there is considerable variation in the amount of black spotting, *Utetheisa lotrix* Cr. varies in the amount of both black and red spotting and *Argina cribraria* Clerck varies in ground colour from orange to white. In the Bombycidae, *Ocinara varians* Wlk. has a brown form *varians* and a grey one *albicollis* Wlk. In the Sphingidae there is *Nephele didyma* F. with its ab. *hespera* F. In the Eupterotidae, many species of *Eupterote* have a brown and a yellow form, among the Lymantriidae *Dasychira mendosa* Hbn. has several forms of the male. Among the Noctuidae *Spodoptera mauritia* Bsd. has a female-like variety of the male, *Ilattia* (*Amyna*) *octo* Guen. has several forms and *Anua coronata* F. shews considerable variation in the size and colour of the reniform. Apart from these well-known varieties, there are a host of unnamed aberrations that occur from time to time.

Genetic variation is not confined to the imago, it may manifest itself in the larva, the pupa or even in the colour of the silk of the cocoon. A rare teratological aberration in the larva of several species of Sphingid exists in which the horn is double. This has been proved to be a recessive. I have never heard of an Indian Sphingid larva exhibiting this abnormality but there is no reason why one should not be found. The presence of a small tubercle on the site of the larval horn in some Sphingid pupae is probably genetic in origin. I once had a brood of *Herse convolvuli* L. in which several of the pupa exhibited this abnormality, but failed to get the F2 generation through. The larva of *Melanitis leda* L. has three types of head coloration: a green head with a narrow brown line running down the sides from the base of the cephalic horns, an all brown head and an intermediate form, which are probably genetic in origin. The larva of *Asota caricae* Bsd. has the head varying from dark crimson to black, the black suffusion spreading from the lower half upward, and this variation may also be genetic. An English Satyrid, *Pararge megera* L., has a green and a jet-black pupal form, this does not seem to be environmental and may well be genetic, and some of the Indian Satyridae may exhibit the same phenomenon. It is also possible that the pink and green pupal forms of *Danaus chrysippus* L. are genetic. There is no lack of problems to be investigated.

Many apparently normal insects may be heterozygous in constitution and there is always the possibility of some interesting aberration arising when brother is mated to sister. It is not usually worth while continuing this type of mating beyond the F2 generation.

I had not intended making any remarks on the subject of breeding methods in this paper, but a word or two would probably not be out of place here. Messrs. Watkins & Doncaster, of 36 Strand, London E.C.1, have recently put on the market a cylindrical celluloid large cage, in which many species of butterfly have been successfully paired. A mixed bunch of flowers for the butterfly to feed on, and of the food-plant for it to lay on, can be put in the cage in a bottle of water and the whole placed in a sunny position. Alternatively a sponge soaked in honey or in sugar and water may be substituted for the flowers. This same type of larva cage is also useful when dealing with the larger species of moths, but many of the smaller ones will pair and lay quite readily in small boxes. Many species will pair more readily if they are exposed to a draught, and the males of many of the Saturniidae and other species that 'assemble' are said not to be capable of mating until they have flown, or at any rate fluttered round their box. There are recorded instances where a male and female moth have sat side by side in a box without taking any notice of each other, and that the male has then been tossed into the air and fluttering down for a yard or so and alighting close to the same female, has immediately paired.

Larval Dimorphism.—We have here a very interesting and diverse set of problems. Dimorphism in larvae may be genetic in origin (the Geometrid genus *Ephyra* for example), it may be a response to environment, either to the colour or the intensity of light, and it may be due to the effect of overcrowding in captivity.

The late Sir Edward Poulton did an immense amount of research into the response of larvae to their surroundings and wrote many interesting papers on the subject. Experimental work consists, roughly, of rearing parts of the same brood of larvae in large, light cages and providing resting places of different colours in each cage; thus a twig-resting Geometer species would have one cage provided with brown twigs, another with green, a third with whitish and a fourth, possibly, with some unnatural colour such as blue or yellow. A bark-resting species, such as a Lasiocampid, would be provided with different, plain-coloured barks in the various cages, and possibly a lichen-covered, mottled bark in another. Another set of experiments could be carried out in which the larvae were reared in jars of differently coloured glass.

An interesting example of genetic dimorphism is found in the larva of an American species of *Colias*. In this species a rare recessive is unable to utilise the yellow constituent of plant chlorophyll, with the result that it is coloured a much bluer green than the normal form and is so conspicuous on its food-plant that it very rarely survives to maturity in a state of nature.

Another very interesting aspect of this problem is found in certain larvae when they are reared in captivity. Many larvae, which normally feed and live in brilliant sunlight, produce a darker form when reared indoors in captivity. Examples of this are *Danaus chrysippus* L., where the narrow black transverse lines of the larva

broaden into stripes, and *Prospalta pallidipennis* Warr., where the normally green, sparsely crimson-marked larva may develop a dorsal series of large, conjoined, crimson blotches, or even assume a bronze ground colour instead of the normal green. These changes are probably due to lack of light, but another group of larvae exhibit a more puzzling change when reared under conditions of overcrowding. In this latter class a certain proportion will be found to assume an unusual coloration when reared in overcrowded conditions, irrespective of the conditions of light, and this form will not appear in batches of larvae which are not overcrowded. I discovered this phenomenon quite accidentally when rearing the Sphingid *Deilephila nerii* L. in rather large numbers and produced a small percentage of larvae in which the normal green coloration was replaced by ochreous, and I have since found that I can usually produce this form of larva by rearing several larvae together in a small receptacle. I have reared numerous single larvae under the same lighting conditions and have never produced any but the green form. I am inclined to believe that overcrowding tends to increase the proportion of brown to green larvae in many *Macroglossum* and *Choerocampid* species, but I have not got sufficient data to make a definite assertion. An unidentified species of *Chloroclystis* also produces a dark form of larva when overcrowded, here a normally plain green larva develops a series of purple-black lateral spots, which, in extreme examples, may become transverse bands across the dorsum. It is not easy to assign a reason for this form of dimorphism. It has been suggested that the accumulation of frass and consequent fouling of the air by a number of larvae in a small receptacle slows down the metabolism, but I did not notice that my *nerii* larvae grew any more slowly when overcrowded. My own view is that when larvae are overcrowded they interfere with each other and move about more than they would normally do, and that this extra movement causes some change in the pigment production, possibly due to increased oxidisation of the blood. Most larvae have a favourite resting position and it might be possible to devise some method which would produce extra movement in solitary larvae, by continually reversing the receptacle containing them for example. If larvae treated in this way when solitary produced the same abnormal form as they did when crowded, it would be a long step to proving this hypothesis correct.

It must not be overlooked that there is a distinct possibility that dimorphism in many larvae may arise from two separate causes: genetic and environmental. It may be that the homozygous larvae are definitely one colour or the other and that it is only the heterozygotes that react to external stimuli. It will require very carefully planned and extensive experiments with larvae of known parentage to determine this.

Pupal Dimorphism. This is a very similar phenomenon to larval dimorphism discussed above. I know of no cases of dimorphism due to mere overcrowding, but there are examples where it is due to genetical causes, the Geometrid genus *Ephyra* for example, and others where it is environmental, or said to be.

The late Sir Edward Poulton was also a worker in this field and carried out a series of experiments forcing larvae to pupate on ob-

jects of special colours or under variously coloured glasses. Using *Aglais urticae* L., he found that the gilded pupae were produced when the larvae pupated on light backgrounds or under yellow glass, whilst dark pupae were produced on dark backgrounds or under blue glass. He found that the larvae were susceptible to this colour stimulus for the very short period of rest between the selection of the pupating site and the spinning of the silken pad, and believed that the stimulus acted on the body as a whole and was not controlled by the eyes as he obtained similar results from larvae whose eyes were coated with black varnish. Another worker came to the opposite conclusion and claimed that larvae whose eyes were varnished yellow always produced gilded pupae, irrespective of the background, and those with their eyes varnished blue always produced dark ones. It will be seen that there is plenty of scope for experiment.

A suitable apparatus for testing the effect of backgrounds can be constructed with a large box containing one or more electric bulbs and covered with a sheet of frosted glass, on which tins enamelled inside in various colours can be stood. Larvae are introduced into these tins as soon as they are ready to pupate and the tins are stood, open end downwards, on the frosted glass which produces a uniform illumination.

Suitable subjects for experiment are the many Papilionid species with a green and a brown pupal form, several Pierids again with a green and a brown form, *Danaus chrysippus* L. with its pink and its green pupa, *Ergolis merione* Cr., which has several different forms, some of the Satyridae with green and brown pupae, and many of the Lycaenidae, which have a green and blackish pupal form connected by intergrades.

My own experiments with the pupa of *Papilio polytes* L. seem to indicate that the production of the brown or the green form depends on something more than mere environment. Elsewhere I have suggested that the brown pupae may be produced from larvae that wander more than usual, the green pupae coming from the larvae that wander little. It has also been suggested that here again is a case where the pupal colour is partly the result of environment and partly of genetical factors.

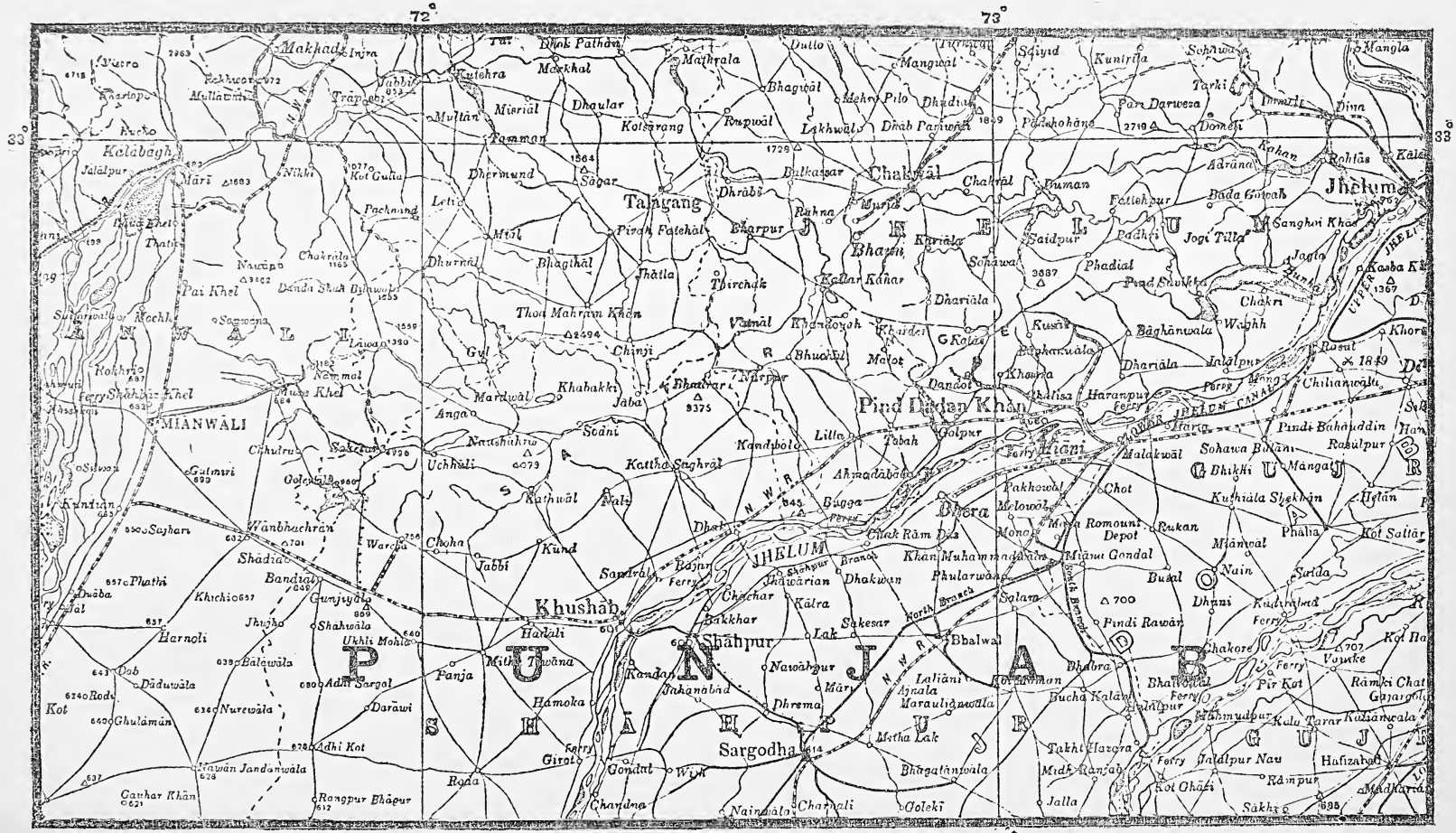
Hybridisation.—A very interesting subject for investigation is the effect of crossing different subspecies of the same species and also two different species. The crossing of subspecies gives us a clue as to how much of the difference is genetic and how much environmental, but it can also have even more surprising results. In a previous section I referred to the X and Y chromosomes that control sex. The production of a female depends on a proper balance between the X chromosome and the autosomes. And it sometimes happens that the X chromosome of one subspecies is more potent than that of another, so that this balance is disturbed in the hybrid and a potential female becomes an intersex. This happens very frequently in the case of hybrids between species and often the balance is so much upset that only one sex survives.

The breeding of hybrids is no easy matter. Normally it is only possible to obtain a pairing between closely related species, and even then such pairings are often sterile. Even if the pairing is

fertile, the offspring are usually very delicate and difficult to rear. The method recommended for moths is to enclose several males of the one species and females of the other together, then to introduce a female of the first species in a small muslin-covered cage, when the males have been excited by the presence of the virgin female of their own species, she is removed and the males are then supposed to mate with the females of the other species. I say 'supposed' as this has never happened on the various occasions I have tried to obtain cross-pairings between different Sphingid species. Even if there is a will to pair, it may be physically impossible owing to the structure of the genitalia. In butterflies pairings between males and females of the same species have been effected by holding the wings shut with a paper clip, exerting slight pressure on the abdomina so that the genitalia are exserted and then bringing the two sets of genitalia into juxtaposition, as soon as the male claspers have taken a grip of the female, the two insects are put gently into a dark box. I have not seen this method advocated for cross-pairings, but there seems no reason why it should not work.

If anyone is lucky enough to obtain a cross-pairing between two species, he should keep a careful comparative note of the appearance of the hybrid in all stages and also, if possible, make comparative drawings or photographs of the hybrid and the parent species.

General Biology.—Many entomologists may not have the time or the inclination to carry out the rather lengthy and detailed work described above. There is still, however, a great deal of useful and interesting work to be done in recording the habits, etc. of the insects they observe and rear. We do not know, for example, how the larva of *Loepa newara* Moore contrives to spin its cocoon at the end of a long stalk. Records of cases where a collector has been deceived by a mimetic species, descriptions of the resting position of protectively coloured insects, the warning display of those that exhibit warning colours and many other things are all worthy of publication, always provided they are accurately recorded. They may provide the piece of evidence needed to complete another's work.



THE PUNJAB SALT RANGE (*Scale* 1" = 16 *miles*)

THE BIRDS OF THE PUNJAB SALT RANGE, (PAKISTAN)

BY

H. W. WAITE, C.I.E., M.B.O.U.

(*With a map and two plates*).

For the purposes of this paper the Punjab Salt Range is taken as starting from the river Indus at Kálabágh and terminating at the junction of the Bunhá torrent with the river Jhelum near Jalalpur some 30 miles west of the town of Jhelum. As thus defined it lies between north latitudes 32° 20′ and 32° 55′ and between east longitudes 71° 35′ and 73° 30′ and forms the southern boundary of the rugged plateau extending from the sub-Himalayas southwards over the greater part of the Rawalpindi, Jhelum and Attock districts.

From the Indus the Range runs south-west in a low and narrow ridge to Nammal, rising thence to the peak of Sakésar (4992′), which is its highest point. It then sweeps round and continues practically due east, more or less parallel to the Jhelum and at an average distance from it of about 12 miles, finally bending southwards to meet that river at Jalalpur.

The distance in a straight line from Kalabagh to Sakesar is roughly 30, and from Sakesar to Jalalpur 80 miles.

From Kalabagh to Sakesar the Range lies in the Mianwali district. Thereafter, except for a portion of the northern slopes in Attock, it is included in the Sháhpur and Jhelum districts, whose boundary crosses it about half way between Sakesar and Jalalpur.

The following physiographical details have mostly been collected from the various district gazetteers. The southern edge of the Range rises precipitously from the plain of the Jhelum river, which lies about 700′ above sea level, to a general height of some 2500′, with several peaks reaching to over 3,000′. On the northern side, however, the hills slope much more gradually towards the plateau, which varies from 1,300′ to 1,900′.

Eastwards from Sakesar the hills consist of two parallel ridges, which open out to a distance of some 16 miles across and then bend towards each other to be connected by a confused mass of smaller ridges about Sodhi. They then again open out to a width of about 8 miles to meet once more at Nurpur, beyond which an area of more or less cultivated upland stretches to Sardhi and Kallar Kahár. East of Kallar Kahar the two main ridges again become prominent and enclose a valley some 4 miles wide until they meet in another confused mass at Choa Saidan Shah. Beyond this the Range has clearly been subjected to great disturbance. The northern hills after culminating in the peak called Chél (3,701′) swing round southward in a broad sweep near Phadiál, some 6 miles north of Ára. This lateral movement is continued until the whole chain reaches, and is merged into, its southern neighbour. Beyond this point of junction the southern hills continue for about 5 miles till they reach the town of Jalalpur. They then wheel abruptly to the north-east and follow a short course to end at the Bunha torrent.

With such differences in altitude of the surrounding country the appearance of the Range differs greatly at various standpoints. From the south the view is dreary. The hills are almost entirely bare of vegetation and a few half-starved and sickly bushes only emphasize the general barrenness. Nor at the eastern end is there much grandeur of form. But towards the west, where the limestone rocks become predominant, there are often long lines of lofty cliffs, best seen in the narrow gorges which carry down the drainage of the interior upland. From the north the Range has the appearance of a low monotonous ridge. There is, however, a fuller vegetation here and the long slopes of the hills are often well covered with brushwood.

The valleys enclosed by the external ridges lie at a general height of from 2,000′ to 2,500′ and are divided from each other by numerous ridges, usually long and narrow and almost all running east and west parallel to the general direction of the Range. Four of them contain lakes namely:—

Uchhali or Sún Sakesar	Average size		1,800	acres
Jáhlar	,,	,,	60	,,
Khabakki	,,	,,	400	,,
Kallar Kahar	,,	,,	180	,,

The water of all is blackish and in drying up exhales a strong briny odour. There are some rush and reed beds at Kallar Kahar but the margins of the others are practically bare. The depth of water at Kallar Kahar nowhere exceeds 4 feet and in years of drought the lake sometimes dries up completely.

At Nammal, where drainage from the plateau has cut a narrow gorge through the hills, a dam was constructed in 1912-13 to conserve water for a small irrigation canal running to Mianwali. The lake thus formed has an average area of 1,800 acres, which is more than doubled by a rise of 10 feet at the dam. Except for some rush beds at the southern end, its margins are bare. The water is fresh and always contains a vast quantity of floating weed.

A few small streams rise in the Range and are used to irrigate fruit gardens before making their way down either to the plateau or through deep and narrow gorges to the Jhelum plain, on reaching which they have become impregnated with salt. The chief garden areas thus irrigated are at Sodhi, Kanhatti (near Khabakki), Kallar Kahar and Choa Saidan Shah.

The soil of the valleys formed by the gradual disintegration of the limestone and sandstone rocks of the hills above is exceedingly fertile and its powers are being constantly renewed by fresh deposits brought down by the torrents. A very elaborate system of embankments is maintained by the industrious peasants, the result of which is that the slopes of the valleys have been gradually worked into a succession of terraces and that in some cases the dams are so strong and so well designed that the natural channel of a large torrent remains perfectly dry even after heavy rainfall. The whole stream is turned on to the ridges on either side and passing gradually down from terrace to terrace irrigates a large area of comparatively high land which would otherwise remain dry and almost unculturable.

Sakesar from Uchhali.

Photos by Author

Kallar Kahar Lake.

Near Nurpur.

Photos by Author

Between Nurpur and Lilla.

The fertile soil of valleys thus irrigated supports a large population and their villages, situated at no great distance from each other, which nestle at the foot of the hills or cluster on the ridges.

The average annual rainfall decreases as one proceeds westwards away from the Himalayas, and ranges from about 30 inches at Jhelum to 18 at Uchhali (at the foot of Sakesar). The peak of Sakesar is an exception, receiving about 23 inches. Roughly speaking three quarters of the rain falls in summer.

While snow sometimes falls, and lies for a time on Sakesar it is very unusual for it to do so elsewhere in the Range.

The temperature in summer is generally about 10 degrees lower than that of the Jhelum plain. Considerable heat is experienced in June and July just before the advent of the monsoon, and the cold in January and February is sometimes severe. The southern base of the hills in summer is probably among the hottest regions of the Indian sub-continent. At Khusháb the temperature rises day after day to 115° or more in the shade, the average daily maximum for June being nearly 108°; in January the average nightly minimum is 41°.

The chief crops raised are wheat and oil-seeds in winter and millets and pulses in summer. Small quantities of maize and melons are also grown. In the fruit gardens are to be found loquats, pomegranates, apricots, almonds, oranges, lemons, grapes, figs and mulberries, the first three predominating.

In general trees of large size are scarce and practically confined to Shisham or Táli (*Dalbergia sissoo*), Mulberry, Pippal (*Ficus religiosa*) and Bohr (*Ficus indica*) planted by the roadsides or at wells and ponds. The most common trees are Phuláh (*Acacia modesta*), wild olive, Van or Jáhl (*Salvadora oleoides*) and Bér (*Zizyphus jujuba*). Less common is Rahúra (*Tecoma undulata*), which makes a brave show with its gorgeous orange blossom. On the top of Sakesar a number of Chir Pine (*Pinus longifolia*) have been planted and have reached a good size, also some Eucalyptus and Juniper, while on its slopes may be found fair specimens of such trees as Kangar (*Pistacia integerrima*) and Kulár (*Bauhinia variegata*).

The brushwood consists chiefly of Sanattha (*Dodonoea burmanniana*) Vahékar (*Adhatoda vasica*), Kari (*Capparis aphylla*) and the thorny bushes Kandhér or Phupári (*Gymnosporia spinosa*), Mallá or Hamlái (*Zizyphus nummularia*) and Jallidhar (*Grewia villosa*). There are many 'reserves' under the control of the Forest Department, some closed, and some open, to grazing. The trees in these are mostly Phulah and olive, which seldom attain any size.

The Salt Range is mentioned occasionally in Whistler's paper on the birds of the Jhelum district (*Ibis*, 1916) and in Hume's 'Nests and Eggs of Indian Birds' are several notes by Theobald from 'about Pind Dádan Khán and Katâs in the Salt Range'. In this connection it should be explained that Pind Dadan Khan is on the bank of the Jhelum 5 miles from the foot of the Range while Katas is in the hills 2 miles west of Choa Saidan Shah.

In the course of official duties and otherwise I paid occasional visits to the Range in most of the thirty years 1918-47. I also spent a considerable time at Dandot in 1932-33 and made stays of one or two months at Sakesar in the latter part of the summers of 1930 and 1931 and of most of those of 1937-46. The following list, which makes no claim to be exhaustive, is based on casual notes and observations in the above-mentioned years and on a collection of a little over 1,000 specimens made in 1927-47 and now in the British Museum. For the identification of the great majority of these I was indebted to the late Hugh Whistler, to whose unfailing interest and encouragement I owe more than can adequately be expressed. A tribute is also due to the keenness and skill of my Indian collector, Lala Sheikh, who obtained a great many of the specimens and prepared all of the skins.

Corvus corax laurencei Hume. Punjab Raven.

Fairly common resident but markedly less numerous than on the plateau and between the hills and the Jhelum river. Breeds from January to March but most eggs, four to six in number, will be found in February. The nest is usually in a cliff.

Corvus splendens zugmeyeri Laubmann. Sind House-Crow.

Resident about many of the villages but in comparatively small numbers. Breeds in June and July. Eggs three to six. Does not ascend Sakesar.

Dendrocitta rufa pallida (Blyth). Sind Tree-Pie.

Common resident wherever there is a sufficiency of fair-sized trees. Nests in April and May. Eggs usually five and occasionally four. Here, as elsewhere, very destructive to the eggs and young of other birds.

Parus major caschmiriensis Hartert. Kashmir Grey Tit.

Common winter visitor, occurring singly or in small parties. Arrives in October and leaves in March, a few remaining on into April.

Parus monticolus monticolus Vigors. Simla Green-backed Tit.

Winter visitor in small numbers, arriving somewhat later and leaving earlier than the last.

Machlolophus xanthogenys xanthogenys (Vigors). Northern Yellow-cheeked Tit.

A female was obtained amongst a party of *P. monticolus* in the gardens at Choa Saidan Shah on 28 February, 1932.

Turdoides terricolor sindianus Ticehurst. Sind Jungle-Babbler.

Resident in most of the gardens and at Sakesar, where a nest with five hard-set eggs was found on 12 July.

Argya caudata caudata (Dumont). Common Babbler.

Abundant resident, breeding chiefly in May, June and July. Nests with incubated eggs were found on 11 April and 24 August. Eggs usually four and occasionally three.

Molpastes cafer pallidus Stuart Baker. Central Indian Red-vented Bulbul.

Common resident in the gardens and also established at Sakesar. May and June are the usual breeding months but eggs may sometimes be found in July. The clutch is generally three or four and occasionally two. Most nests are built in trees and are seldom less than six feet from the ground, eight to ten feet being the usual height. At Sakesar a snake was shot in the act of devouring one of two fledged young in a nest about twelve feet up in a kangar tree.

Molpastes leucogenys humii Oates. Hume's White-eared Bulbul.

Abundant resident, frequenting gardens and jungle alike and absent only from the barest tracts. Nests from April to July. The earliest date on which eggs were found was 15 April and latest 1 August. The full clutch is normally three but only two are sometimes incubated and I have four records of four. The nest is usually placed some three or four feet up in phulah or ber trees or *Gymnosporia* bushes. A small series of this race was collected at Jalalpur whence the type was obtained in 1871.

Certhia himalayana limes Meinertzhagen. Western Himalayan Tree-Creeper.

Common winter visitor from October to March.

Tichodroma muraria (Linnaeus). Wall-Creeper.

Uncommon winter visitor. Earliest date noted 3 November and latest 25 February. A favourite haunt is the gorge below the Nammal dam.

Saxicola caprata bicolor Sykes. Northern Indian Pied Bush-Chat.

Fairly common summer visitor from March to September, the males arriving first. Earliest date noted 6 March. Breeds in April, May and June. The nest is usually on the ground at the foot of a boulder but sometimes in a hole in a rock. The full clutch seems to be invariably four.

Saxicola torquata indica Blyth. Indian Bush-Chat.

Winter visitor in small numbers from September to April, in both of which months there is a marked passage increase. In Hume's ' Nests and Eggs' (2nd ed., Vol. ii, p. 48) it is stated that they occasionally breed in the Salt Range, but my confirmation of this in *Jour. Bom. Nat. Hist. Soc.*, 29 : 295 was made in error : I did not see the bird actually on the nest, which I now feel certain was that of *S.c. bicolor*.

Oenanthe picata (Blyth). Pied Chat.

Occurs in fair numbers at Sakesar on the autumn passage and a few may be seen about the hills until March. Earliest date noted 9 August.

Oenanthe capistrata (Gould). White-headed Chat.

The commonest of the chats occurring in the Range. Arrives in August and leaves about the middle of March. Earliest date noted 10 August.

Oenanthe oenanthe leucorhoa (Gmelin). Greenland Wheatear.

Winter visitor in small numbers from August to March. Earliest date noted 26 August.

Oenanthe deserti deserti (Temminck). Desert-Chat.

Fairly common winter visitor from October to March. Earliest date noted 23 September and latest 18 March.

Oenanthe xanthoprymna chrysopygia (De Filippi). Red-tailed Chat.

Winter visitor in small numbers from October to March. Haunts bare and boulder-strewn slopes. Earliest date noted 19 October and latest 15 March.

Phoenicurus erythronotus (Eversmann). Eversmann's Redstart.

Occurs sparingly as a mid-winter visitor. Only observed in January and February and usually in the vicinity of the lakes.

Phoenicurus ochruros phoenicuroides (Moore). Kashmir Redstart.

Abundant winter visitor from September to April. Earliest date noted 31 August and latest 3 May.

Chaimarrhornis leucocephalus (Vigors). White-capped Redstart.

Uncommon winter visitor. Seen on the stream at Choa Saidan Shah in January and the Bunha torrent in November.

Luscinia svecica svecica (Linnaeus). Red-spotted Bluethroat.

Luscinia svecica pallidogularis Zarudny.

Bluethroats occur sparingly in the neighbourhood of the lakes throughout the winter and in fair numbers on passage in April-May and September-October. Of six specimens collected five were assigned by Whistler to *pallidogularis* and one, taken at Nammal on 15 January, to the typical race. Earliest date noted 23 August.

Saxicoloides fulicata cambaiensis (Latham). Brown-backed Indian Robin.

Very common resident, frequenting scrub jungle more than cultivated areas. Breeds from March to August, the nest being placed in the shelter of a boulder or in holes or crevices in rocks. Eggs normally four, frequently three and occasionally two. Here, as elsewhere, pieces of snake-skin are commonly incorporated in the nest.

Copsychus saularis saularis (Linnaeus). Indian Magpie-Robin.

A few are resident in some of the gardens. Observed at Sodhi in May and Kallar Kahar in December.

Turdus atrogularis Jarocki. Black-throated Thrush.

Common winter visitor to the gardens. Earliest date noted 6 November and latest 21 March.

Turdus viscivorus (Verreaux). Himalayan Mistle-Thrush.

A female was obtained in a garden at Kallar Kahar on 3 February, 1939.

Monticola cinclorhyncha Vigors. Blue-headed Rock-Thrush.

Only observed at Sakesar, where it appears regularly in small numbers in the first half of August. The first arrivals are all juveniles.

Monticola solitaria pandoo (Sykes). Indian Blue Rock-Thrush.

Winter visitor in fair numbers and usually met with on rocky ground in the vicinity of water. Earliest date noted 24 August and latest 11 April.

Monticola saxatilis (Linnaeus). Rock-Thrush.

Fairly common on passage at Sakesar in August-September and met withsparingly until the end of October as far east as Nurpur. Earliest date noted 24th August.

Myiophoneus coeruleus temminckii Vigors. Himalayan Whistling-Thrush.

Winter visitor in small numbers from October to March. Earliest date noted 27 September and latest 23 March.

Prunella atrogularis huttoni (Horsfield & Moore). Black-throated Accentor.

Occurs not uncommonly as a winter visitor from November to February. Found both singly and in flocks. Earliest date noted 5 November and latest 13 March.

Prunella strophiata jerdoni (Brooks). Jerdon's Accentor.

A female was obtained at Sakesar on 30 January, 1929 during a spell of exceptional cold when the Range had one of its rare falls of snow.

Muscicapa striata neumanni Poche. Eastern Spotted Flycatcher.

Occurs at Sakesar in some numbers on passage in the second half of August and beginning of September. In 1946 I was astonished to find a couple haunting the garden of one of the bungalows there as early as 6 July. They were seen to attack a Tree-Pie in a most determined manner and pursue it for some distance. I never observed this bird elsewhere in our area but Whistler obtained one at Sandhi on 10 September (Ibis, 1916 : 59).

Muscicapa parva parva Bechstein. Red-breasted Flycatcher.

Only met with on the autumn passage in October-November when it was seen frequently in small parties.

Tchitrea paradisi leucogaster (Swainson). Himalayan Paradise Flycatcher.

Common summer visitor. Earliest date noted 4 April and latest 30 September. Breeds in May, June and July. The loquat tree is the favourite for nesting purposes and after that the mulberry and fig. Nests may also be found in phulah and willow. The tree selected is always close to running water and the nest may be at any height from two to eighteen feet from the ground. The normal number of eggs is four but three are often incubated and I once found seven, presumably the produce of two birds.

Lanius excubitor lahtora (Sykes). Indian Grey Shrike.

Common resident. Nests in March and April in thorny trees such as phulah and ber. Eggs three or four. Occurs well above 4,000 on Sakesar.

Lanius vittatus Valenciennes. Bay-backed Shrike.

Abundant summer visitor from March to September. Earliest date noted 9 March. Breeds in April, May and June. The favourite tree for the nest is the phulah, but the ber is frequently utilized and, on Sakesar, the olive. The nest is usually from six to eight feet up, but I have seen it as low as four, and as high as twenty in a shisham. Eggs normally four and occasionally three.

Lanius schach erythronotus (Vigors). Rufous-backed Shrike.

Resident in small numbers. Most often met with in the gardens and on Sakesar. Breeds in May and June. The few nests found were from eight to fifteen feet up in thorny trees.

Lanius isabellinus Hemprich & Ehrenberg. Isabelline Shrike.

A female was obtained at Dandot on 13 January, 1932.

Tephrodornis pondiceriana pallida Ticehurst. Sind Wood-Shrike.

Uncommon resident. Only observed in the neighbourhood of Dandot, Choa Saidan Shah and Nurpur. A nest with four slightly incubated eggs was found on 15 April.

Pericrocotus brevirostris brevirostris (Vigors). Indian Short-billed Minivet.

A party of four females was seen in the gardens at Kallar Kahar on 24 March, 1947.

Pericrocotus peregrinus peregrinus (Linnaeus). Small Minivet.

Pericrocotus peregrinus pallidus Stuart Baker.

Observed in small parties from December to March. Of five specimens collected three were referred by Whistler to *pallidus* and two, taken at Dandot in December, to the typical form. Whistler (Ibis, 1916 : 55) shot a female from a nest with three eggs at Choa Saidan Shah on 26 May, 1913. Its breeding in our area must, I think, be exceptional as I never saw a minivet there in summer.

Dicrurus macrocercus albirictus Hodgson. Himalayan Black Drongo.

Abundant summer visitor from March to October. Breeds in May and June. Any fair sized tree is used for the nest, which is generally towards the end of a branch and not less than fifteen feet from the ground. Eggs normally four but three are often incubated.

Agrobates galactotes familiaris (Ménêtries). Grey-backed Warbler.

Appears regularly in small numbers on passage at Sakesar about the middle of August. Earliest date noted 10 August. Not met with elsewhere in the Range.

Acrocephalus stentoreus brunnescens (Jerdon). Indian Great Reed-Warbler.

Only observed on passage in May, when it occurs in fair numbers in reed-beds on the stream at Choa Saidan Shah and on the Kallar Kahar lake.

Acrocephalus dumetorum Blyth. Blyth's Reed-Warbler.

Abundant passage-migrant in May and August. Earliest dates noted 6 May and 30 July.

Acrocephalus agricola (Jerdon). Paddy-field Warbler.

Observed on passage at the end of April and beginning of May in the same localities as *A. stentoreus*.

Orthotomus sutorius guzurata (Latham). Indian Tailor-bird.

Resident in small numbers in the gardens but I never found a nest.

Lusciniola melanopogon mimica Madarász. Eastern Moustached Sedge-Warbler.

Occurs sparingly as a winter visitor to the Kallar Kahar and Nammal lakes. Earliest date noted 24 October. While waiting in the reeds for a shot at duck I have often had one creeping about within reach of my hand.

Cisticola juncidis cursitans Franklin. Streaked Fantail-Warbler.

Status uncertain. Observed at Kallar Kahar in June and July and at Dandot in August. A nest with one egg was found in a clump of rushes on the Kallar Kahar lake on 8 July; it was about a foot from the surface of the water.

Franklinia buchanani (Blyth). Rufous-fronted Wren-Warbler.

Common resident in scrub jungle. Nests with eggs were found in June and July.

Hippolais caligata rama (Sykes). Sykes's Tree-Warbler.

Hippolais caligata scita (Eversmann). Booted Tree-Warbler.

Apparently spring and autumn passage-migrants. Of five specimens taken at Sakesar and Dandot from 27 July to 19 August. Whistler assigned three to *rama* and two (one, a juvenile, doubtfully) to *scita*. On the spring passage *rama* was obtained once, at Dandot on 25 April. It may be mentioned that *rama* breeds in grass jungle on the Indus near Mianwali in March and April.

Sylvia communis rubicola Stresemann. Whitethroat.

Occurs commonly at Sakesar on passage in August and September. Also obtained in August at Dandot. Earliest date noted 11 August.

Sylvia hortensis jerdoni Blyth. Indian Orphean Warbler.

Met with in small numbers on passage at Sakesar in July and August and once obtained at Kallar Kahar in the latter month. Earliest date noted 15 July. Two specimens taken in July were juveniles.

Sylvia nana nana (Hemprich & Ehrenberg). Desert Warbler.

Occurs sparingly as a mid-winter visitor on the sandy and boulder-strewn waste at the southern foot of the hills, which it does not ascend.

Sylvia althæa Hume. Hume's Lesser Whitethroat.

Apparently a double passage-migrant. Arrives at Sakesar towards the end of July and is fairly common there till the beginning of September. On the spring passage I only obtained it once, at Kallar Kahar on 27 April.

Sylvia curruca blythi Ticehurst & Whistler. Siberian Lesser Whitethroat.

Fairly common winter visitor. Earliest date taken 17 August and latest 2 May.

Sylvia curruca halimodendri Suschkin. Lesser Whitethroat.

Three whitethroats collected at Dandot and Choa Saidan Shah in November and December were assigned by Whistler to this race.

Sylvia curruca minula Hume. Small Whitethroat.

Winter visitor, and met with much less frequently than *S. c. blythi*. Taken at Sakesar on 12 September and above Naushahra and below Ara in January and February.

Phylloscopus collybita tristis Blyth. Brown Willow-Warbler.

Common winter visitor, chiefly frequenting the neighbourhood of the Nammal and Kallar Kahar lakes. Earliest date taken 15 October and latest 4 May.

Phylloscopus griseolus Blyth. Olivaceous Willow-Warbler.

Apparently a double passage migrant. Passes through Sakesar in fair numbers in August and September. Earliest date taken 11 August. On the spring passage I obtained it once, at Choa Saidan Shah on 6 April.

Phylloscopus subviridis (Brooks). Brooks's Willow-Warbler.

Winter visitor in small numbers. Met with at Nurpur in December and at the foot of the hills near Warcha and Ara in January and February.

Phylloscopus inornatus humei (Brooks). Hume's Willow-Warbler.

One, unsexed, was taken at Kallar Kahar on 1 February, 1939.

Phylloscopus trochiloides nitidus (Blyth). Green Willow-Warbler.

Occurs in fair numbers on passage at Sakesar in August and September and one was obtained at Kallar Kahar on 23 October. Earliest date taken 2 August.

Phylloscopus trochiloides viridanus (Blyth). Greenish Willow-Warbler.

Met with in fair numbers on passage at Sakesar in August and September and also at Dandot in the former month. Earliest date taken 12 August.

Phylloscopus occipitalis occipitalis Blyth. Large Crowned Willow-Warbler.

Twice obtained at Sakesar on 29 July, 1937 and 20 August, 1942.

Scotocerca inquieta striata (Brooks). Streaked Scrub-Warbler.

Only observed at Sakesar, where it is resident but uncommon. Stuart Baker ('Nidification', 2 : 454) states that the breeding season lasts from February well into June but the normal laying season is probably from the end of February to the middle of April. I was never at Sakesar during these months and the only nest that I found there contained four fresh eggs on 13 August. It was built between four and five feet up in a small and scraggy wild olive and was most conspicuous. In construction it was a worn looking and untidy domed affair of grass, well lined with silky fibre, some felt-like vegetable substance and a few feathers. The parent birds were remarkably fearless, flitting about and perching within a few feet of me while I examined the nest.

Suya criniger striatula Hume. Sind Brown Hill-Warbler.

Resident, and one of the commonest birds, at Sakesar but was never observed elsewhere in the Range. Breeds in July and August but I once found eggs as early as 10 June. The number of these varies from two to five, but four is the normal clutch. The nests are built either in rank herbage or in small bushes overgrown with grass at a height of from one to two feet from the ground. They are always domed and the eggs do not differ in any way from those of the typical race. Its monotonous reeling song may be heard till the end of September.

Prinia inornata terricolor (Hume). Indian Wren-Warbler.

Uncommon. Presumably resident, but I only met with it in winter and nowhere but Kallar Kahar.

Oriolus oriolus kundoo Sykes. Indian Golden Oriole.

Common summer visitor from April to September. Breeds in May and to a lesser extent in June. I once found a nest with young as early as 12 May. Eggs two to four but three is the normal clutch. Most nests are from ten to twenty feet up in shisham and mulberry trees, but occasionally the phulah is chosen and rarely the loquat. One in a phulah was only five feet from the ground with a nest of *Dicrurus macrocercus* about the same height above it.

Pastor roseus (Linnaeus). Rosy Pastor.

Double passage-migrant, both in small parties and large flocks, in April-May and August-September. A solitary bird was once observed at Sodhi on 29 June.

Sturnus vulgaris porphyronotus Sharpe. Central Asian Starling.

Sturnus vulgaris poltaratzskii Finsch. Finsch's Starling.

Winter visitors from October to March, the second being much the commoner of the two. The reed-beds of the Kallar Kahar lake are a favourite roosting place.

Temenuchus pagodarum (Gmelin). Black-headed Myna.

Whistler (Ibis, 1916: 58) saw a few at Choa Saidan Shah at the end of May and the end of June 1913. It is, however, no longer to be found there nor did I ever come across it elsewhere in our area.

Acridotheres tristis tristis (Linnaeus). Common Myna.

Abundant resident breeding chiefly in May and June. The earliest date on which eggs were found was 15 April and latest 6 July. Eggs three or four but two were once found hard-set. Like the House-Crow it is absent from Sakesar.

Acridotheres ginginianus (Latham). Bank Myna.

I never saw this bird in the Range until 7 April, 1947, when a small and very restless flock was encountered on the margin of the Kallar Kahar lake. Six of them sat in a row for a minute or two on the back of a grazing buffalo. A week later a few were seen by the Khabakki lake.

Uroloncha malabarica (Linnaeus). White-throated Munia.

Resident, but by no means common. The only nest found was in a small ber tree on the bank of a stream and contained two eggs on 23 July.

Coccothraustes coccothraustes humii Sharpe. Hume's Hawfinch.

Only met with twice, in a forest reserve near Nurpur in the third week of March, 1943 and 1947. There was a good-sized flock on the former occasion but only a few birds on the latter. Is not uncommon in winter in the Kala Chitta hills some 30 miles north across the plateau.

Propasser rhodochlamys grandis Blyth. Red-mantled Rose-Finch.

The female of a pair was obtained in the Gardhála valley below Choa Saidan Shah on 12 November, 1932. Whistler (Ibis, 1916: 68) recorded that Captain Whitehead shot a female below Sardhi in December.

Carpodacus erythrinus erythrinus (Pallas). Common Rose-Finch.

Carpodacus erythrinus roseatus (Hodgson).

Double passage-migrants appearing at Sakesar in flocks at the end of August and beginning of September. Earliest date noted 18 August. Of ten taken there in those months in various years Whistler identified five as *roseatus* and five as the typical race. In spring it is common in April about Dandot, Choa Saidan Shah and Kallar Kahar, where the ripe mulberries are a great attraction. Earliest date noted 19 March. Four spring specimens were all referred by Whistler to *roseatus*.

Bucanetes githaginea crassirostris (Blyth). Eastern Desert-Finch.

Met with in small numbers at the foot of the hills near Warcha salt-mines and between Nammal and Músa Khél, where it is apparently resident. A male obtained near Nammal on 15 April had its organs in breeding condition, but search for a nest proved unsuccessful.

Acanthis cannabina fringillirostris (Bonaparte & Schlegel). Eastern Linnet.

Winter visitor, occurring in small flocks from October to March. Earliest date noted 19 October.

Gymnorhis xanthocollis transfuga Hartert. Sind Yellow-throated Sparrow.

Common summer visitor from April to August. Earliest date noted 22 March. Breeds in May, the eggs numbering three or four. All nests found were in holes in trees at heights of from four to twenty feet from the ground.

Passer domesticus indicus Jardine & Selby. Indian House-Sparrow.

Abundant resident. April and May seemed to be the principal nesting months and four the usual number of eggs.

Passer domesticus riseogularis Sharpe. Kashmir House-Sparrow.

Double passage-migrant. Obtained from large flocks of sparrows about Dandot in March and at Sakesar in September.

Passer hispaniolensis transcapicus Tschusi. Tschusi's Sparrow.

Winter visitor. Found in flocks about Pail and Kallar Kahar in the last week of October and at Nammal in the beginning of December.

Emberiza schoeniclus pallidior Hartert. Central Asian Reed-Bunting.

A male was shot in a rush-bed on the Nammal lake on 15 January. It is common along the Indus from Kalabagh to Mianwali in December-February.

Emberiza stewarti Blyth. White-capped Bunting.

Winter visitor in fair numbers, the majority arriving in August. Earliest date noted 30 July and latest 9 April.

Emberiza cia par Hartert. Transcaspian Meadow-Bunting.

Fairly common winter visitor from October to March.

Emberiza bruniceps Eversmann. Red-headed Bunting.

Double passage-migrant, occurring in flocks in August (earliest date noted 30 July) and April-May.

Emberiza striola striolata (Lichtenstein). Striolated Bunting.

Status uncertain but probably only a winter visitor. Observed at Sakesar in fair numbers in August (earliest date taken 29 July) and in both the Shahpur and Jhelum portions of the Range in January and February. A juvenile was obtained at Kallar Kahar on 4 September.

Riparia riparia diluta (Sharpe & Wyatt). Siberian Sand-Martin.

A male, one of several hawking over the Kallar Kahar lake, was taken on 3 May, 1933.

Riparia rupestris (Scopoli). Crag-Martin.

Met with sparingly throughout the year in suitable localities and so presumably resident, but I never succeeded in locating a nest. In August a couple was found haunting an untenanted bungalow at Sakesar.

Hirundo rustica rustica Linnaeus. Common Swallow.

Found roosting in some numbers in the reed-beds at Kallar Kahar at the beginning of August, and a solitary bird was noted there in the middle of February.

Hirundo smithii filifera Stephens. Wire-tailed Swallow.

Fairly common summer visitor from April to September. Breeding starts soon after arrival and continues into August. The nest is usually affixed to the roof of a verandah, less often to the overhang of a rock in the bed of a stream. At Dandot a pair was found building in the horizontal shaft of an abandoned coal-mine. Three is the normal number of eggs.

Hirundo daurica erythropygia Sykes. Sykes's Striated Swallow.

Summer visitor in small numbers from April to September. Breeds in May, June and July. The overhang of a cliff or the roof of a cave are the usual sites for the nest.

Motacilla alba dukhunensis Sykes. Indian White Wagtail.

Mainly a double passage-migrant. Fairly common on the margins of the lakes in March-April and October, and a few may be met with throughout the winter.

Motacilla alba personata Gould. Masked Wagtail.

One, unsexed, was obtained on passage at Sakesar on 9 September, 1940.

Motacilla maderaspatensis Gmelin. Large Pied Wagtail.

Fairly common resident on the streams and margins of the lakes. Nests in April, but eggs may sometimes be found in the second half of March. The nest is always close to water, usually in the shelter of a boulder and sometimes in a loose stone wall. At Choa Saidan Shah a pair nested for three years running on a small rock partially screened by rushes in the middle of the stream, the nest being only an inch or two above the surface of the water. Eggs normally four and occasionally five.

Motacilla cinerea caspica (Gmelin). Eastern Grey Wagtail.

Winter visitor in small numbers from October to April and largely reinforced in both of these months by passage-migrants.

Motacilla flava beema Sykes. Indian Blue-headed Wagtail.

Observed in small numbers at Nammal in the middle of April and Kallar Kahar at the end of April and beginning of May. It doubtless occurs also on the autumn passage, and two females taken at Sakesar on 27 August are probably of this race.

Motacilla flava thunbergi Billberg. Grey-headed Wagtail.

Double pastage-migrant. Met with in small numbers at Kallar Kahar at the end of April and beginning of May, and on the return passage a male was obtained there on 4 September.

Motacilla citreola calcarata (Hodgson). Hodgson's Yellow-headed Wagtail.

Double passage-migrant. Observed in small numbers at Khabakki in the middle of April and at Kallar Kahar in March-April and beginning of May. A male was taken at Kallar Kahar as early as 11 August on the autumn passage.

Anthus trivialis trivialis Linnaeus. Tree-Pipit.

Observed in fair numbers at the end of August and beginning of September. Presumably also occurs on the spring passage but I have no note of meeting with it then.

Anthus similis decaptus Meinertzhagen. Persian Rock-Pipit.

Resident, but its numbers appear to decrease considerably in winter. Breeds in June, July and August and is then quite common at Sakesar. The earliest date on which eggs were found was 11 June and latest 21 August. The nest is built in grass in the shelter of a stone or small bush and is always well concealed. In construction it is a shallow cup of coarse grass lined with finer grass and, occasionally, a small amount of goat's hair. Eggs two to four but three is the normal number.

Anthus rufulus waitei Whistler. North-western Indian Pipit.

Status uncertain. Fairly common in summer at Kallar Kahar, where it nests on the grass lands adjoining the lake from April to July. Two nests found there about a hundred yards apart were built in dry pats of cattle-dung round which grass had grown in a clump, one being roofed with a flake of the dung. Eggs three or four.

Anthus campestris griseus Nicoll. Eastern Tawny Pipit.

Fairly common winter visitor. Earliest date noted 25 August and latest 22 March.

Anthus spinoletta blakistoni Swinhoe. Chinese Water-Pipit.

Winter visitor in small numbers. Taken at Uchhali and Kathwai in February.

Alauda arvensis cinerascers Ehmcke. Eastern Skylark.

Mid-winter visitor. Common in flocks in the wheat-fields in February.

Calandrella brachydactyla longipennis (Eversmann). Yarkand Short-toed Lark.

Winter visitor. Observed in large flocks in January and February, usually on grass lands in the vicinity of the lakes.

Mirafra javanica cantillans Blyth. Singing Bush-Lark.

Only observed at Dandot, where two males were obtained in the second half of August, one being shot from a nest. This was a shallow pad of grass, sheltered by a small plant in the middle of a field of millet about a foot high, and contained four well-incubated eggs.

Mirafra erythroptera sindiana Ticehurst. Sind Red-winged Bush-Lark.

Status uncertain. Met with in small numbers at Jahlar at the end of February, Nurpur in the middle of March and at the foot of the hills near Musa Khel in the middle of November.

Galerida cristata chendoola (Franklin). Indian Crested Lark.

Abundant resident, breeding from March to July. The nest is generally built in the shelter of a stone or small plant and in most cases is encircled by flakes

of sun-dried earth or cattle-dung. One was found in a cattle foot-print on salt-encrusted ground some twenty yards from the edge of the Uchhali lake. Another was little more than a foot from a well used footpath. Eggs normally three, occasionally two or four, and I once found one that was moderately well incubated.

Ammomanes phoenicura phoenicura (Franklin). Indian Rufous-tailed Finch-lark.

One, unsexed, was obtained at Kathwai on 2 August, 1927. It occurs in small flocks on the plateau to the north of the Range in July-September.

Ammomanes deserti phoenicuroides (Blyth). Indian Desert Finch-Lark.

Abundant resident, chiefly haunting the barren stony slopes and nullahs on both sides of the Range. The nest is very hard to find, apart from the discomfort of searching for it in the scorching heat of its bare and arid surroundings. Three nests, two containing four incubated eggs and one three that were fresh, were taken in the latter half of May. Two were on slopes and one in a dry torrent-bed. All were shallow cups of grass in the shelter of large stones and were supported by ramparts of twigs, roots and flat pieces of stone. One was thickly lined with sheep's wool but there was no such material in the others.

Eremopterix grisea siccata (Ticehurst). Sind Ashy-crowned Finch-Lark.

Whistler (Ibis, 1916 : 80) found it common at Sardhi and obtained a male and nestling there on 10 September, 1913. I failed to meet with it anywhere in our area.

Eremopterix albifrons affinis (Blyth). Indian Black-crowned Finch-Lark.

One, unsexed, was obtained at the foot of the hills below Ara on 21 February, 1932. Whistler (**loc. cit. sup.**) recorded that Captain Whitehead met with it in fair numbers in December some four miles north of Lilla, i.e. at the foot of the hills below Sardhi.

Zosterops palpebrosa occidentis Ticehurst. North-western White-eye.

Common resident in the gardens. Breeds in May, June and July, and I once found eggs as late as 7 August. The nest is usually from five to seven feet from the ground, but one was taken about twenty feet up in a large apricot tree and another at only three feet in a loquat. Eggs normally three, occasionally four and sometimes only two.

Cinnyris asiatica brevirostris (Blanford). Sind Purple Sunbird.

Abundant summer visitor. Earliest date noted 5 March and latest 11 August. Breeding starts soon after arrival, and eggs, two or three in number, may be found till the end of June. The nests are built in trees and bushes at heights varying from two to six feet from the ground.

Picus squamatus squamatus Vigors. Himalayan Scaly-bellied Green Woodpecker.

Confined to Sakesar, where it is resident in small numbers. I was never there early enough in the year to find an occupied nest-hole.

Dryobates scindeanus (Horsfield & Moore). Sind Pied Woodpecker.

Dryobates mahrattensis aurocristatus Tickell. Northern Yellow-fronted Pied Woodpecker.

Both of these woodpeckers are resident, the second common and the first fairly so. So far as my observations go the former alone occurs at Sakesar.

Brachypternus benghalensis dilutus Blyth. Sind Golden-backed Woodpecker.

Only observed at Choa Saidan Shah, where it appeared to the resident in very small numbers.

Iynx torquilla torquilla Linnaeus. Wryneck.

Winter visitor in small numbers. Earliest date noted 28 August. Appears to leave early and was not observed after February.

Megalaima virens marshallorum Swinhoe. Himalayan Great Barbet.

A few are resident in the gardens at Choa Saidan Shah. On 5 June, 1926, three young birds, almost ready to fly, were found in a natural hole some 25 feet up in the branch of a large mulberry. In May, 1933, a pair was watched excavating a hole in the trunk of another mulberry. The work appeared to be finished by 18 May but I had to leave before any eggs were laid.

Megalaima haemacephala lutea (Lesson). Indian Crimson-breasted Barbet.

Resident at Jalalpur but so far as I know does not ascend the hills.

Cuculus canorus canorus Linnaeus. Common Cuckoo.

Double passage-migrant in small numbers. Observed regularly at Sakesar in the first week of August (earliest date noted 28 July) and obtained at Kallar Kahar in the middle of April. Only once seen in the hepatic phase.

Clamator jacobinus serratus (Sparrman). Pied Crested Cuckoo.

Occurs sparingly as a summer visitor. Earliest date noted 4 June and latest 25 August. An egg was taken from a nest of *Argya caudata* on 29 June and young birds were met with in July.

Eudynamis scolopaceus scolopaceus (Linnaeus). Koel.

Uncommon summer visitor. Earliest date noted 4 May and latest 6 August.

Centropus sinensis sinensis (Stephens). Common Crow-Pheasant.

A few are resident at Kallar Kahar and Nammal, where they haunt the rush-beds on the edge of the lakes. Also occasionally observed in the gardens at Kallar Kahar.

Psittacula eupatria nepalensis Hodgson. Indian Large Paroquet.

Psittacula krameri borealis Neumann. Rose-ringed Paroquet.

Resident, and do much damage in the fruit gardens. *Krameri* is common and *eupatria* comparatively scarce. Eggs of the former were found in April.

Psittacula cyanocephala bengalensis (Forster). Blossom-headed Paroquet.

Only observed at Sakesar, where a male was obtained from a party of three on 18 July, 1937.

Coracias garrula semenowi Loudon & Tschusi. Kashmir Roller.

Fairly common on passage in August. Earliest date noted 25 July.

Coracias benghalensis benghalensis Linnaeus. Indian Roller.

Apparently resident in small numbers and largely reinforced by summer visitors. Nests with eggs may be found in May.

Merops apiaster Linnaeus. European Bee-eater.

Only observed at Sakesar, where it appears in fair numbers on passage at the end of August and beginning of September. Earliest date noted 18 August.

Merops orientalis orientalis Latham. Common Indian Green Bee-eater.

Abundant summer visitor. Earliest date noted 9 March and latest 23 September. Breeds in May. Eggs normally six and occasionally five.

Merops superciliosus javanicus Horsfield. Blue-tailed Bee-eater.

Merops superciliosus persicus Pallas. Blue-cheeked Bee-eater.

Large bee-eaters were observed in some numbers round the Kallar Kahar lake from April to August, along the stream at Choa Saidan Shah in May, at Dandot in August and about the Khabakki and Nammal lakes in October. The Dandot birds were *javanicus* and the Nammal ones *persicus*. I never came across a breeding colony, but once found a solitary nest on a hill-side at Choa Saidan Shah. The bird, which dashed out as I passed, was not secured but was probably *javanicus*. This was on 18 May and there were five incubated eggs.

Ceryle rudis leucomelanura Reichenbach. Indian Pied Kingfisher.

Once seen in February on a stream near Ara, doubtless a straggler from the Bunha torrent below.

Alcedo atthis bengalensis Gmelin. Common Indian Kingfisher.

Occasionally observed at Choa Saidan Shah in summer, and Whistler (Ibis, 1916 : 83) obtained a female there on 1 July. Also seen at Kallar Kahar at the end of April and at Kathwai in July.

Halcyon smyrnensis smyrnensis (Linnaeus). White-breasted Kingfisher.

Common resident, breeding in April and May. Eggs four to six.

Upupa epops Linnaeus. Hoopoe.

Common in summer but seemed to disappear in November and return towards the end of February. Breeding starts in April.

Micropus melba melba (Linnaeus). Alpine Swift.

Occurs regularly on passage at Sakesar in July–September. Earliest date noted 14 July. Some parties pass straight over while others remain for a few days and hawk in company with *M. affinis*. Many were once seen in February feeding very low after heavy rain at the foot of the hills below Kathwai.

Micropus affinis affinis (Gray). Common Indian House-Swift.

Mainly a common summer visitor from March to September and may be met with in small numbers throughout the winter. Breeds in March–May and again in July–August. Nests usually in the roof of verandahs and stables and at Dandot a colony was found in the horizontal shaft of a disused coal-mine.) Occasionally a pair usurps a Striated Swallow's nest. There is a large colony in the overhang of an inaccessible cliff near Kallar Kahar. Eggs normally three but two are often incubated.

Caprimulgus europaeus unwini Hume. Hume's Nightjar.

Fairly common summer visitor from May till the beginning of September. Breeds chiefly in June and July. The earliest date on which eggs were found was 22 May and latest 11 August. They are laid on stony ground amidst a plentiful growth of *Dodonoea* and *Gymnosporia* bushes and may occasionally be found on the steep side of a ravine. They are nearly always in the shelter of a bush, often one of fair size. Single incubated eggs were found on two occasions. The steady whirring note is uttered both on the ground and from a bush or tree On the wing the call is very similar to that of *C. monticolus*.

Caprimulgus mahrattensis Sykes. Sykes's Nightjar.

Apparently a summer visitor and confined to the stony waste dotted with van trees along the southern foot of the hills. It arrives and breeds early, eggs being usually found from the middle of March to the end of April. Two clutches were, however, taken, and brought to me, in the last week of July. The eggs are usually laid at the foot of a vêna (*Khazya* sp.) or harmal (*Peganum harmala*) plant. I never heard any call uttered other than a low chuckle when flushed during the day.

Caprimulgus monticolus monticolus Franklin. Franklin's Nightjar.

Summer visitor, arriving and departing at the same time as *C. europaeus* but in much smaller numbers. Breeds in June and July in the same localities as that bird, the eggs being laid at the foot of, or fairly close to, a plant or small bush. The call, a shrill and penetrating *choo-ee*, is mostly uttered on the wing.

Asio flammeus (Pontoppidan). Short-eared Owl.

A female was obtained at Dandot on 16 March, 1933.

Bubo bubo bengalensis (Franklin). Indian Great Horned Owl.

Resident in small numbers. Met with at Choa Saidan Shah and around Nurpur and Naushahra. A male shot in the first-mentioned locality on 6 March had its organs approaching breeding condition.

Bubo coromandus coromandus (Latham). Dusky Horned Owl.

Resident at Katha Sagral, a few miles from the foot of the Range below Pail, but not observed anywhere in the hills.

Otus brucei (Hume). Striated Scops Owl.

Obtained at Sakesar in July and September and below Sardhi in March. I believe it to be the only owl that occurs at Sakesar and what was possibly its call, heard occasionally in July, rather resembled the noise made by inflating a motor-tyre.

Athene brama indica (Franklin). Northern Spotted Owlet.

Resident in comparatively small numbers.

Sarcogyps calvus (Scopoli). Black Vulture.

Resident in small numbers. Breeds in March. The few nests found were on stunted phulah trees on steep hill-sides.

Gyps indicus jonesi Whistler. Himalayan Long-billed Vulture.

Resident, and nests commonly in the precipices along the southern face of the Range. Eggs are laid at the beginning of January but I have one taken as late as 3 February.

Pseudogyps bengalensis (Gmelin). Indian White-backed Vulture.

Generally to be seen at a carcase in company with the last, but sometimes the congregation consists of this species only. Does not breed anywhere in the hills. In Hume's 'Nests and Eggs', 2nd ed., Vol. 3, p. 206 there is a note by Theobald that it nests in large trees. There may possibly have been some trees of sufficient size about Katas in his day, but this is open to doubt and there certainly is none such now.

Neophron perenopterus perenopterus (Linnaeus). Large White Scavenging Vulture.

Resident but much less common than on the plateau and in the Jhelum riverain. Breeds in April but eggs, two in number, many sometimes be found in the last week of March. The nests are in natural hollows and ledges in cliffs, chiefly in the nullahs along the northern base of the hills.

Gypaëtus barbatus hemachalanus Hutton. Himalayan Bearded Vulture.

Observed occasionally throughout the year and the whole length of the Range. Doubtless nests somewhere in the cliffs around Sakesar, where it was most often seen.

Falco peregrinus Tunstall. Peregrine Falcon.

May occasionally be seen in winter at Kallar Kahar. One made a magnificent stoop at a flock of teal just as they were passing in front of my 'hide'.

Falco jugger Gray. Laggar Falcon.

Resident, but by no means common. Nests on ledges in cliffs in March and April.

Falco subbuteo subbuteo Linnaeus. Hobby.

One, unsexed, was obtained at Sakesar on 19 September, 1940 and another was seen there in August and September, 1942.

Falco chiquera chiquera Daudin. Red-headed Merlin.

Probably resident in very small numbers. Observed at Dandot in June and near Nurpur in October. Breeds commonly early in March between the hills and the Jhelum and on the plateau to the north.

Falco tinnunculus Linnaeus. Kestrel.

Common in August and September about Sakesar, where I once saw a party of five, and observed occasionally throughout the winter. A few pairs undoubtedly breed in our area and a nest with four eggs was found on 17 April in the earthen cliff of a nullah on the northern slopes. A couple was seen at Dandot in March and April and Whistler (Ibis, 1916: 97) saw a couple at Choa Saidan Shah on 30 June.

Aquila rapax vindhiana Franklin. Indian Tawny Eagle.

Observed occasionally throughout the year. Breeds commonly in February and March between the hills and the Jhelum and on the plateau. The only nest found in the Range was about 30 feet up in a shisham at Kallar Kahar and contained one hard-set and one addled egg on 20 February.

Hieraëtus fasciatus fasciatus (Vieillot). Bonelli's Eagle.

Noted occasionally at Sakesar and pairs were also seen in the gorges below Choa Saidan Shah and Sardhi. Doubtless breeds in the cliffs along the southern face of the Range but I never located an eyrie. Hume ('Nests and Eggs', 2nd ed., Vol 3, p. 140) found many pairs breeding in the precipices near the Mayo (salt) mines at Khewra. That locality, however, is no longer favoured, Khewra being now a centre of cement and chemical manufacture and, at night, a blaze of electric light.

Circaëtus gallicus (Gmelin). Short-toed Eagle.

Occasionally observed at Sakesar in August and September and once between Uchhali and Naushehra in March. I never found a nest in our area but in a copy of Hume's 'Nests and Eggs' given to me by Mr. C. G. D. Farquhar, Indian Police, who served for some time in the Jhelum District, there is a marginal note in his handwriting against this species as follows: 'Two nests in shisham trees about 25 feet from ground on very top of tree, 19-2-'94. One with well grown young one and one with a young one able to fly. Nests of twigs. Kallar Kahar, Jhelum'.

Butastur teesa (Franklin). White-eyed Buzzard-Eagle.

Only observed at Sakesar in August when it occurs there in fair numbers.

Haliaëtus leucoryphus (Pallas). Pallas's Fishing-Eagle.

Winter breeding visitor. Earliest date noted 26 September. There are eyries at all of the lakes except Jahlar. There being no fish, except small ones at Nammal, the birds prey chiefly on waterfowl. I have watched them catching Little Grebes at Kallar Kahar, hovering low over the water and seizing the victim as it surfaced after a dive.

Milvus migrans govinda Sykes. Common Pariah Kite.

Abundant resident, breeding in March and April.

Circus pygargus (Linnaeus). Montagu's Harrier.

An immature female was shot at Kallar Kahar on 27 April. In that month and in August harriers are commonly seen on passage but this was the only specimen secured.

Circus æruginosus æruginosus (Linnaeus). Marsh Harrier.

Winter visitor in small numbers. Earliest date noted 4 September and latest 3 May.

Buteo rufinus rufinus (Cretzschmar). Long-legged Buzzard.

Theobald's statement (Hume's 'Nests and Eggs' 2nd ed., Vol 3, p. 126) that *Buteo ferox* breeds in our area has long been discredited. Although this bird is common on the plateau in winter and has marked passage through Rawalpindi in October–November. I never came across it anywhere in the Range.

Astur badius dussumieri (Temminck). Indian Shikra.

Apparently a summer visitor from March to September, but one was obtained at Kallar Kahar as early as 1 February. Breeds in April and May, nesting usually in shisham and mulberry trees near running water. Eggs three or four.

Accipiter nisus melanoschistus Hume. Sparrow-Hawk.

Only met with in October, when there appears to be a passage across the Range. A male and two females were obtained near Nurpur at the end of that month.

Columba livia neglecta Hume. Hume's Blue Rock-Pigeon.

Very common resident, nesting in buildings and in colonies in the cliffs. Eggs taken in March and May.

Columba palumbus casiotis (Bonaparte). Eastern Wood-Pigeon.

Resident in small numbers at Sakesar, and a few pairs used to nest in the Gandhala Valley below Choa Saidan Shah. Two nests found in the latter locality on 12 April and 4 June contained young birds. They were both about 18 feet up, one in a ber and the other in a shisham. Of three nests with eggs found at Sakesar, one on 13 June and two on 9 July, one was in a chir pine, one in a kangar and the third in a ban oak (*Quercus incana*).

Streptopelia senegalensis cambayensis (Gmelin). Indian Little Brown Dove.

Very common resident, breeding from April to August. The phulah is the favourite tree for the nest.

Streptopelia decaocto decaocto (Frivalszky). Indian Ring-Dove.

Very common resident, breeding chiefly from April to July. The nest is usually in ber or phulah. There is a noticeable decrease in the numbers of both this and the last in mid-winter, when doubtless many seek warmer quarters at the foot of the hills.

Oenopopelia tranquebarica tranquebarica (Hermann). Indian Red Turtee-Dove.

Common summer visitor from the middle of April till the end of August. Breeds in May and June. Most nests are in shisham trees and from 12 to 15 feet from the ground but one was found not less than 30 feet up in a large mulberry.

Pterocles orientalis (Linnaeus). Imperial Sand-Grouse.

Uncommon winter visitor. Small parties were observed occasionally in mid-winter between Kallar Kahar and Nurpur and a solitary male was once seen on 21 February.

Pterocles indicus (Gmelin). Painted Sand-Grouse.

Resident in fair numbers. Nests both in the hills and on the stony and broken ground at their southern base. Most eggs will be found in March and April, but it also lays in May and June and I have two clutches taken at the beginning of October. The nest is usually a mere scrape, with a few pieces of grass or straw in the hollow, but one was found in which a neatly made pad of grass had been provided. Eggs normally three and occasionally two. The bird is a close sitter and will sometimes allow itself to be caught on the nest.

Pterocles exustus ellioti Bogdanow. Common Indian Sand-Grouse.

Occurs in small flocks in the hills in winter but mostly frequents the ground between them and the Jhelum. Breeds commonly from March to May in the stony waste along the foot of the hills. Eggs, normally three and occasionally two, may also be found in June, and I have one clutch taken on 15 October.

Pavo cristatus Linnaeus. Common Peafowl.

Resident in a semi-feral state in the gardens at Kallar Kahar and below Sardhi, where they are associated with shrines and so not molested. A nest with four eggs was found on 1 June.

Coturnix coturnix coturnix (Linnaeus). Common Quail.

Occurs on passage in comparatively small numbers in March-April and August-September, when I have flushed it on the very top of Sakesar. Earliest date noted 29 February.

Alectoris graeca koriakovi Zarudny. Persian Chukar.

Resident and common in suitable localities. Breeds chiefly in April and May, but eggs may sometimes be found at the end of March and as late as the first half of August. The clutch varies from seven to nine but I have one record of thirteen. Breeding is on a much reduced scale in years of drought.

Ammoperdix griseogularis griseogularis (Brandt). See Partridge.

Common resident at all levels. Breeds in March and April. Nests with from eight to sixteen eggs were found from 1 to 9 April and one with twenty-eight on 25 April.

Francolinus pondicerianus interpositus Hartert. Northern Grey Partridge.

Common resident, breeding chiefly in April and May. Eggs from six to eight, but I once had ten brought to me, which were said to have been taken from a nest at the foot of the hills on 30 March.

Turnix sylvatica dussumieri (Temminck). Indian Little Button-Quail.

Theobald (Hume's ' Nests and Eggs ' 2nd ed., Vol. 3, p. 371) stated that it bred in our area in August. I frequently heard the booming call in the millet fields round Nurpur in that month, but never found a nest nor obtained a bird.

Rallus aquaticus korejewi Zarudny. Turkestan Water-Rail.

Met with in fair numbers in the reed beds of the Kallar Kahar lake at the beginning of February.

Porzana pusilla pusilla (Pallas). Eastern Baillon's Crake.

Occurs in some numbers on passage at Kallar Kahar at the end of April and beginning of May.

Gallinula chloropus indicus Blyth. Indian Moorhen.

Status uncertain. Observed in small numbers at Kallar Kahar from the beginning of May till the end of October. It undoubtedly breeds there as chicks in down were seen in July.

Porphyrio poliocephalus poliocephalus (Latham). Indian Purple Moorhen.

A few are resident at Kallar Kahar. A nest with two eggs containing dead chicks was found there on 8 July.

Fulica atra atra Linnaeus. Coot.

Occurs on all of the lakes in varying numbers throughout the year being always most numerous in winter. I never saw any evidence of breeding.

Hyrophasianus chirurgus (Scopoli). Pheasant-tailed Jacana.

Observed in small numbers at Kallar Kahar from April to July and doubtless breeds there but I never found a nest.

Rostratula benghalensis benghalensis (Linnaeus). Indian Painted Snipe.

Met with in small numbers at Kallar Kahar from April to July. An apparently deserted nest with two rotting eggs was found there on 1 July.

Megalornis grus (Linnaeus). Common Crane.

Anthropoides virgo (Linnaeus). Demoiselle Crane.

Flocks of cranes of either or both of these species may frequently be seen crossing the Range on the autumn passage in August and September. They fly at a great height and sometimes circle over the lakes for a short while before passing on. The earliest dates on which flocks were observed in various years are given below:—

1938	15 August	1943	21 August
1939	22 ,,	1944	28 ,,
1940	27 ,,	1945	28 ,,
1942	26 ,,	1946	2 September.

On the spring passage I only noted them twice, on 29 February and 5 April.

Chlamydotis undulata macqueeni (Gray). Houbara.

Uncommon winter visitor. A few were observed on sandy ground between Kallar Kahar and Nurpur, and between Pail and Naushahra, in December.

Cursorius coromandelicus (Gmelin). Indian Courser.

Noted in small numbers on fallow land and stony waste from March to May and also in December. Apparently resident, but I never succeeded in finding a nest.

Larus ichthyaetus Pallas. Great Black-headed Gull.

A solitary female was shot on the Khabakki lake on 25 October, 1943.

Larus ridibundus ridibundus Linnaeus. Black-headed Gull.

Winter visitor to the lakes in small numbers and one was once seen on a village pond. Earliest date noted 17 October and latest 14 April.

Chlidonias hybrida indica (Stephens). Indian Whiskered Tern.

Apparently a summer visitor. Observed in small numbers on the Kallar Kahar lake from May to October and probably breeds there but I never found a nest.

Gelochelidon nilotica nilotica (Gmelin). Gull-billed Tern.

Two males were secured from a number seen on the Nammal lake in the middle of April, 1939.

Sterna aurantia Gray. Indian River-Tern.

Sterna melanogaster Temminck. Black-bellied Tern.

Both of these terns frequent the Nammal lake in fair numbers throughout the winter.

Leucopolius alexandrinus alexandrinus (Linnaeus). Kentish Plover.

A female was obtained at Kallar Kahar on 23 December, 1930.

Charadrius dubius curonicus Gmelin. European Little Ringed-Plover.

Apparently a double passage-migrant. Not uncommon at Khabakki and Kallar Kahar in April and October.

Charadrius dubius jerdoni (Legge). Indian Little Ringed-Plover.

Taken at Nammal in January and Kallar Kahar in August. Doubtless breeds in the wide torrent-beds running into the Nammal lake.

Vanellus vanellus (Linnaeus). Green Plover.

Winter visitor in small numbers. Earliest date noted 15 November and latest 21 March.

Chettusia gregaria Pallas. Sociable Lapwing.

A male was shot from a flock of about a dozen on the margin of the Khabakki lake on 17 October, 1947.

Chettusia leucura (Lichtenstein). White-tailed Lapwing.

A male was obtained at Kallar Kahar on 16 October, 1943.

Lobivanellus indicus indicus (Boddaert). Indian Red-wattled Lapwing.

Apparently resident and strongly reinforced by summer visitors, which begin to arrive in the second half of February. Breeds from April to June. It is not unusual to find only three incubated eggs.

Himantopus himantopus himantopus (Linnaeus). Black-winged Stilt.

May be seen in fair numbers on all of the lakes except Jahlar throughout the year. Breeds at Kallar Kahar in June and July. Thirty-five nests were counted there on 22–23 June, 1925 and twenty-six on 13 June of the following year. While four is the normal number of eggs three are frequently incubated and occasionally two, and I once found five. When the nests are approached the birds are loud in their protests, flapping their wings and jumping about in a frenzied manner. The nests are built round the margin of the lake where the water is about six inches deep. They usually consist of a heap of weedy scum collected and built up, with a small reed clump as foundation, to a height of a few inches above the water. These small mounds of mud appear above the surface these are utilized instead of heaps of scum. In years of drought the scum, which then covers large areas of the lake's surface, becomes baked to a hard crust and eggs are sometimes laid on this with nothing but a few bits of grass beneath them. In 1946 there was a growth of reeds and grass at one end of the Uchhali lake and a considerable number of birds were seen there at the beginning of July. Judging from the commotion caused when a villager waded in to drive out a grazing buffalo they were nesting there also.

Recurvirostra avosetta Linnaeus. Avocet.

A solitary bird was observed at Kallar Kahar on 21 March and H. W. Wells, the Bombay Natural History Society's mammal collector, shot four males from a flock of eight there on 1 May. A flock of similar size was seen at Khabakki on 17 October.

Numenius arquata lineatus Cuvier. Eastern Curlew.

A female was obtained at Kallar Kahar on 13 October, 1943 and a male at Uchhali twelve days later. On 7 November, 1925 I saw one which a villager had shot that day at Kallar Kahar.

Limosa lapponica lapponica (Linnaeus). Bar-tailed Godwit.

A female was taken at Nammal on 2 October, 1940.

Tringa ocrophus Linnaeus. Green Sandpiper.

Actitis hypoleucos (Linnaeus). Common Sandpiper.

Fairly common winter visitors from the middle of August till the beginning of May.

Tringa glareola Linnaeus. Wood-Sandpiper.

Winter visitor and common passage-migrant in April. Latest date noted 2 May.

Tringa totanus eurhinus Oberholser. Eastern Redshank.

Occurs sparingly as a winter visitor, its numbers increasing considerably on passage in March and October.

Tringa erythropus (Pallas). Dusky Redshank.

A female was obtained at Kallar Kahar on 21 March, 1943.

Glottis nebularia (Gunnerus). Greenshank.

Observed in small numbers at Kallar Kahar on passage in April and October.

Philomachus pugnax (Linnaeus). Ruff and Reeve.

Occurs in small flocks on passage in March April and the end of September.

Erolia temminckii Leisler. Temminck's Stint.

Common winter visitor from November to April. Latest date noted 2 May.

Capella gallinago gallinago (Linnaeus). Fantail Snipe.

Limnocryptes minima (Brünnich). Jack Snipe.

May be met with in small numbers throughout the winter but are mainly passage migrants in March and September.

Platalea leucorodia major (Temminck & Schlegel). Indian Spoonbill.

Small parties occasionally visit some of the lakes. Observed at Kallar Kahar at the end of June and Nammal at the beginning of October.

Pseudibis papillosus (Temminck). Indian Black Ibis.

A party of five was seen flying over the Kallar Kahar lake on 3 May, 1933.

Ciconia nigra (Linnaeus). Black Stork.

One was seen at Kallar Kahar on 17 April, 1947.

Xenorhynchus asiaticus asiaticus (Latham). Black-necked Stork.

A couple was seen in the low hills near Jalalpur on 24 February, 1921.

Ardea cinerea Linnaeus. Grey Heron.

A few may generally be seen on the lakes from October to May.

Egretta sp ?

Both large and small Egrets were observed on the lakes at various times in winter but no specimen was secured.

Ardeola grayii (Sykes). Indian Pond-Heron.

Apparently resident and reinforced by summer visitors. Breeds in June and July. There is a colony in a large bohr tree at Kallar Kahar.

Nycticorax nycticorax nycticorax (Linnaeus). Night-Heron.

Summer visitor in small numbers. Earliest date noted 17 April. A few pairs nest in the gardens at Kallar Kahar.

Ixobrychus minutus minutus (Linnaeus). Little Bittern.

A female was obtained on the stream at Choa Saidan Shah on 3 June, 1933

Phoenicopterus ruber antiquorum Temminck. Flamingo.

A flock may be seen on one or more of the lakes, except Jahlar, throughout the year. The strength varies but is generally greater in winter. A solitary bird in juvenile dress was observed at Khabakki on 14 April.

Anser anser Linnaeus. Grey Lag Goose.

Occurs in comparatively small numbers at Nammal and, occasionally, at Kallar Kahar. Earliest date noted 16 November.

Tadorna tadorna (Linnaeus). Sheldrake.

A flock of five was seen at Nammal on 16 January, 1933 and of twenty at Uchhali on 3 March 1948.

Casarca ferruginea (Pallas). Ruddy Sheldrake.

A few may be seen on most of the lakes from October to April.

Anas platyrhyncha platyrhyncha Linnaeus. Mallard.

Met with in small numbers from the end of October to April. A few stay on into May.

Anas streptera Linnaeus. Gadwall.

Large flocks may be seen on the Kallar Kahar and Khabakki lakes in October—November and again in March. Fair numbers remain throughout the winter. Latest date noted 14 April.

Anas penelope Linnaeus. Wigeon.

Arrives in fair strength in October and may be met with sparingly throughout the winter. Its numbers increase again in March—April.

Anas crecca crecca Linnaeus. Common Teal.

Common from October to April. Observed at Kallar Kahar as early as the first week of September and as late as 9 July.

Anas acuta acuta Linnaeus. Pintail.

Moderately common in October and April but its numbers are few in the intervening months. Earliest date noted 17 October and latest 3 May.

Anas querquedula Linnaeus. Garganey.

Whistler (Ibis, 1916 : 117) met with a couple at Sardhi on 12 September and I once saw a few at Kallar Kahar on 10 April.

Spatula clypeata (Linnaeus). Shoveler.

Common from the middle of October to the middle of May, a good many staying on into June. Most numerous in November and March. A dozen or so were seen at Kallar Kahar as late as 24 June.

Marmaronetta angustirostris (Ménétries). Marbled Duck.

Only met with at Kallar Kahar in November, in which month single birds were shot there in 1918, 1921 and 1922 and a couple in 1925.

Netta rufina (Pallas). Red-Crested Pochard.

Only seen once when a female, presumably a pricked bird, was obtained at Kallar Kahar on 24 June.

Aythya ferina (Linnaeus). Common Pochard.

Fairly common from October to April, a few staying on into May. Observed in considerable numbers at Khabakki on 3 October.

Aythya rufa rufa (Linnaeus). White-eyed Pochard

Aythya fuligula (Linnaeus). Tufted Pochard.

May be met with in fair numbers from October to April. Seen at Kallar Kahar as early as 20 September and as late as 17 May.

Erismatura leucocephala (Scopoli). Stiff-tailed Duck.

Occasional winter visitor. Three were shot at Nammal on 27 November, 1922 (*Journal Bombay Nat. Hist. Soc.*, 29 : 563) and I noted some at Kallar Kahar on 31 December, 1939. On 4 March, 1948 I watched a flock of about twenty at Khabakki and of thirty odd at Kallar Kahar eight days later. These appeared to carry the tail either cocked at an angle of about 45° or flush with the surface of the water.

Mergus albellus Linnaeus. Smew.

Large flocks visit the Nammal lake in winter and sometimes greatly outnumber the duck. Occasionally seen at Kallar Kahar, and I once shot one in December on a jheel a few miles south of Nurpur.

Phalacrocorax carbo (Linnaeus). Cormorant.

Phalacrocorax javanicus (Horsfield). Little Cormorant.

Both visit the Nammal lake in small numbers in winter.

Podiceps cristatus (Linnaeus). Great Crested Grebe.

Observed in fair numbers at Nammal on 17 November, 1929 and a few were seen at Khabakki at the end of October, 1946 and 1947.

Podiceps ruficollis capensis Salvadori. Little Grebe.

Common resident. Eggs, four to seven in number, may be found in the second half of April but the chief breeding months are May and June. Thirty-eight nests were counted on the Kallar Kahar lake on 13 June, 1926.

[Mr. J. H. Butter informs us that he shot a fine Scaup drake (*Aythya marila marila*) on Nammal lake on 24-12-1948. EDS.]

SCIAENIDS OF THE WEST COAST OF MADRAS PROVINCE[1].

BY

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(*With one plate and one text figure*)

The group of Sciaenid fishes, locally termed 'Kora' by the Malabar fishermen, was popularly designated as 'Jew fish' by Hornell, a former Director of Madras Fisheries, for the reason, that the music produced by the fish reminds one of the playing of the Jew's harp. But according to Jordan (4) Jew fish is the name given to an entirely different group, viz. certain great bass. According to Fowler (2) the Sciaenids are often known as croakers, grunters, or drums, because they produce sounds usually heard under the water during their breeding season.'

IMPORTANCE OF THE FISHERY:

According to Lin (5) Sciaenids constitute one of the most important groups of Chinese food fishes, the annual catch being estimated to fetch even twenty million dollars. On the West Coast of India also, the Sciaenids occur abundantly and they rank high among the economically important food species on the West Coast of Madras Province, as shown in the table below:—

1925-26	9
1926-27	8
1927-28	9
1928-29	4
1929-30	11
1930-31	11
1931-32	8
1932-33	14
1933-34	14
1934-35	8
1935-36	12
1936-37	9
1937-38	8
1938-39	9
1939-40	13
1940-41	12
1941-42	11
1942-43	14
1943-44	11
1944-45	8

The rank ranges between 4 and 14 among the major fisheries of the West Coast and the average for the twenty years given above, works out to 10.

The species of Sciaenids, such as *Sciaena diacanthus* (Lacépede) which grows to five feet according to Day (1) and *Sciaena coitor* (Ham. & Buch.) growing up to three feet in length, provide prime fish for the tables of the rich and are in great demand. When comparatively large shoals of these are obtained, they are either cured or iced and sent to inland markets. Fowler (2) has noted the high value of this fishery, due to the large size to which, some of the species grow and their well-flavoured flesh. The other species

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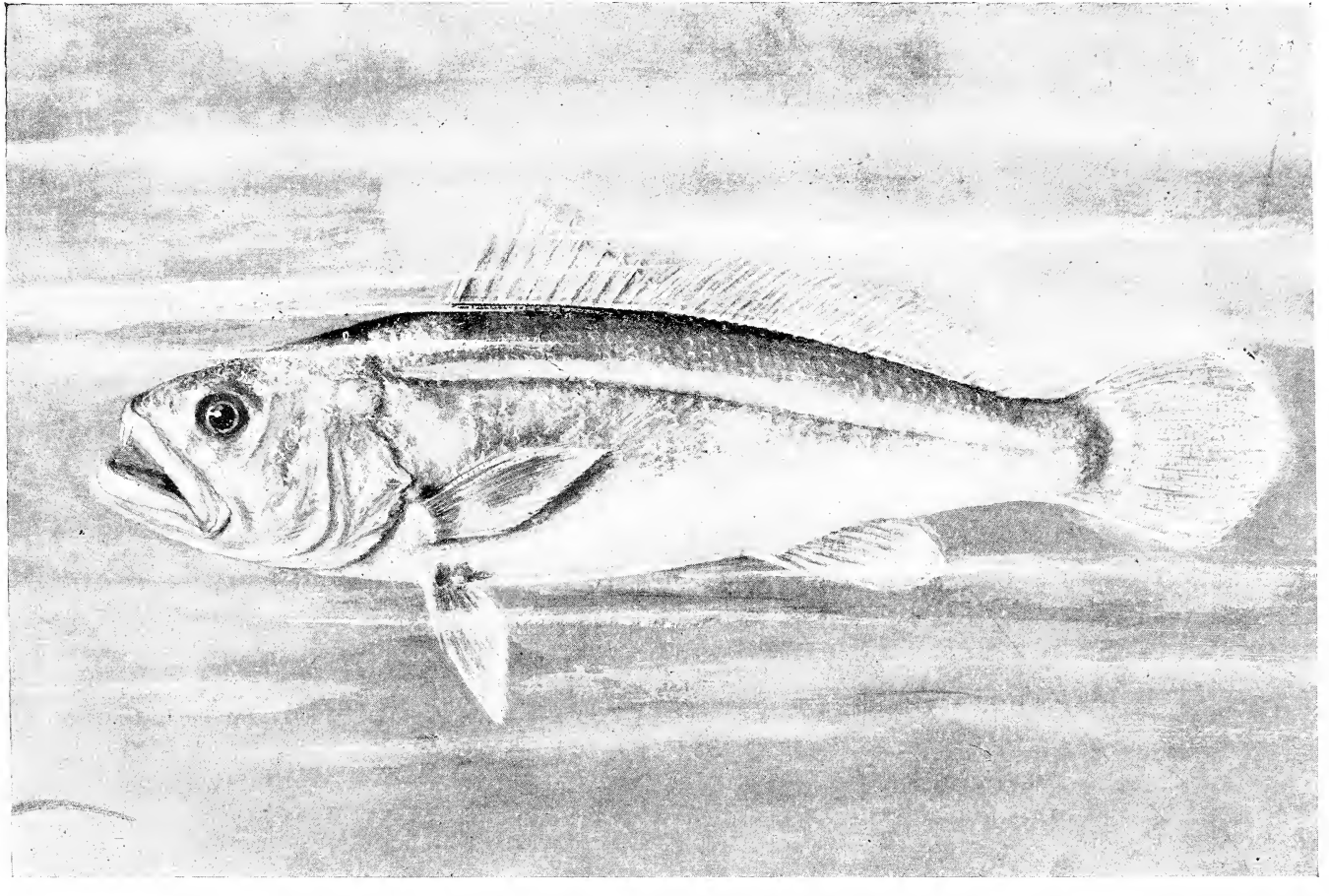
[1] Published with the kind permission of the Director of Industries and Commerce, Madras.

[2] The computation is according to fisheries year beginning with July of one year and ending with June of the succeeding year.



Otolithus ruber (Bl. & Schn.) *P. K. Jacob.*

which do not attain a large size are collectively termed locally 'Korakutty' meaning young ones of Jew fish. These are often caught in large numbers either exclusively or with other miscellaneous fishes like soles, thread-fins, anchovies, white-baits and prawns. These small species of Jew fish provide food for the masses. Even from the earliest times, the air-bladders of the larger species were exported for the manufacture of isinglass. A few species such as *Sciaena diacanthus* and *Sciaen coitor* are hunted by anglers as they afford good sport.

While describing the systematics of Sciaenids of China, Lin (5) asserts that a thorough knowledge of the biology of these important fishes is undoubtedly essential for all projects of developing the fishery. This note is a preliminary report on the attempt made at the West Hill Biological Station, in this direction. The following species contribute to the Jew fish fishery of the West Coast of Madras Province.

1. *Otolithus ruber* (Bl. & Schn.)
2. *Otolithus argenteus* Cuv. & Val.
3. *Otolithus maculatus* Cuv. & Val.
4. *Sciaena carutta* (Bl.)
5. *Sciaena coitor* (Ham. & Buch.)
6. *Sciaena belangeri* (Cuv.)
7. *Sciaena osseus* (Day.)
8. *Sciaena dussumieri* (Cuv.)
9. *Sciaena diacanthus* (Lacép.)
10. *Johnius semiluctosa* (Cuv.)
11. *Umbrina macroptera* (Blk).
12. *Umbrina dussumieri* (Val.)
13. *Umbrina sinuata* (Day.)

1. Otolithus ruber (Bl. & Schn.)

Food: (*a*) Phytoplankton:

Thalassiothrix sp.
Biddulphia sp.

(*b*) Fish:

Stolephorus spp. (White bait.)
Cynoglossus semifasciatus Day.
(Malabar Sole, small specimens).
Fish scales.
Fish eggs.

(*c*) Crustaceans:

Young and adult prawns.

Otolithus ruber is essentially piscivorous in habit. This fish is locally termed 'Palli kora' due to the conspicuous canines (Fig. 1) with the help of which it preys on other fishes. It follows shoals of white bait and prawns and preys on them indiscriminately. A specimen 16 cm. long had three specimens of white-bait 4 cm., 3.5 cm. and 3 cm. long respectively in its stomach. A specimen 19 cm. long, examined on 2-7-'40, had swallowed 37 prawns. Out of the 153 specimens examined from the samples collected during the past decade, 53 specimens were found to have fed on prawns, while 41 had white baits as their stomach contents. Prawns appear as pinkish masses in the stomach. As in the case of the Big-jawed Jumper, this Jew fish competes with a number of species of economically important fishes, by feeding mainly on white baits and prawns which are important links in the food chain of the sea.

The phytoplanktonic organisms, seldom met with, might have entered the stomach accidentally.

Spawning season:

Specimens with ripe gonads were often met with in the catches during the months of May and August. As spent ones were available at the close

of this period, this period constitutes in all likelihood, the spawning season of this species.

Size ranges:

According to Day (1) *Otolithus ruber* attains a total length of 76 cm. The majority of the commerical catches consisted of specimens ranging from 15 cm. to 25 cm. in length. The largest specimen examined in the laboratory measured 28 cm. This fish attains maturity when it reaches a length of 14 cm.

Methods of capture and fishes caught along with *Otolithus ruber.*

Otolithus ruber is usually caught in the common seine net 'Paithu vala', the drift net 'Ayla chala vala' and the cast net 'Veechu vala' operated either from the shore or in the inshore waters.

It is captured along with shoals of white baits and prawns which it follows and preys upon. It is also caught with the Big-jawed Jumper, *Lactarius lactarius* (Cuv. & Val.) and other Jew fishes, which are competitors for the same food, and along with the Malabar Sole, *Cynoglossus semifasciatus* (Day.).

2. **Otolithus argenteus** (Cuv.)

Food:

In its feeding habits, *O. argenteus* resembles *O. ruber.* The following items constituted the food of the species: *Stolephorus* spp. (white bait) prawns, carangid larvae, fish scales and polychaete worms.

Out of the fifty specimens examined forty had *Stolephorus* spp. (White bait) and twenty five had prawns. White baits and prawns form the main food of a number of economically important fishes and hence this Jew fish competes with them by sharing the same food. A comparatively small specimen 8.6 cm. long had 26 young prawns in its stomach. The bottom feeding tendency of this fish is revealed by the presence of polychaete worms and fish scales found in its stomach.

Spawning season:

The spawning season of this species almost coincides with that of *Otolithus ruber.* Mature specimens, with gonads in advanced stages of development were met with, as early as in April. Specimens with gonads in roe were met with in May, June and July. The spawning season therefore appears to be from April to July.

Size ranges:

The majority of specimens examined ranged from 15 cm. to 20 cm. The size of the largest specimen examined was 30 cm. long. According to Day (1) it grows to 76 cm. It first attains maturity when it reaches 12 cm. in length.

Methods of capture and fishes caught along with *Otolithus argenteus*:

Otolithus argenteus is often caught in the common seine net 'Paithu vala' and the cast net 'Veechu vala' along with *O. ruber, Sciaena* spp. the Jew fishes *Cynoglossus semifasciatus* (Day.) the Malabar Sole *Sillago sihama* (Forsk.) the Indian whiting, *Polynemus* spp. the Thread fins, *Platycephalus* sp. the crocodile fish *Engraulis* spp. the Anchovies, *Stolephorus* spp. the white baits and prawns.

3. **Otolithus maculatus** Cuv. & Val.

These were rather rare in the catches and only a few specimens could be examined. A female specimen 19 cm. long, caught in the month of July was found to be in roe with plenty of fat in the abdomen. Specimens were obtained in February also. They were caught in the seine net 'Thattu vala' and seemed to have fed on small fish.

4. Sciaena carutta (Bl.).

Food: (*a*) Zooplankton.

Copepoda.
Paracalanus sp.
Leucifer sp.
Foraminifera.
Radiolaria.
Larval crabs.

(*b*) Fish.

Stolephorus spp. the white baits.
Cynoglossus semifasciatus (Day) the Malabar Sole.
Sciaena spp. the Jew fish.
Fish scales.
Fish eggs.
Prawns.

(*c*) Other marine forms.

Gammarus sp.
Young crabs.
Polychaete worms.

Sand grains.

As in other species of Jew fish, white bait and prawns constitute the major food of this species also. Out of 209 specimens examined 100 specimens had fed on prawns and 61 had white bait. There was an interesting instance when all the thirty-four specimens obtained from the same haul had white bait in their stomachs. It is likely that this shoal came across a shoal of white bait coming from the opposite direction. This is warranted by the fact, that the victims were noticed to have been swallowed head first.

An interesting case of cannibalism was observed in this species once, when a young one of the same species was found in the stomach of one specimen.

The presence of a large number of planktonic organisms in the food, absent in the *Otolithus* spp. referred above, is also interesting. The bottom feeding habit is all the more pronounced in this species, as can be deduced from the frequent presence of radiolarians, fish scales and sand grains. The combination of fish scales and sand grains found in the stomachs confirms the carrion feeding habits of this species.

Spawning season:

The gonads of the specimens examined in the months of March, April, and May were found to be ripe. They were found to be in roe again in September, October and November. This species thus seems to have two long spawning seasons. Plenty of specimens of this species measuring below 2 cm. were caught in May 1942.

Methods of capture, and fishes caught along with *Sciaena carutta.*

Sciaena carutta are often caught along with other species of Jew fish and other miscellaneous varieties, in the common seine net 'Paithu vala'. The miscellaneous varieties consist of *Clupea thoracata* the white sardine, *Leiognathus* spp. the Silver bellies, *Engraulis* spp. the Anchovies, *Hemiramphus* sp. the half beaks, *Stolephorus* spp. the white baits, *Cynoglossus semifasciatus* the Malabar sole and *Dussumieria hasseltii* the rainbow sardine.

Size ranges:

According to Day *Sciaena carutta* attains a length of 30 cm. The majority of specimens examined in this investigation varied from 10 cm. to 15 cm. in total length. This fish attains maturity when 10 cm. in length.

5. Sciaena coitor (Ham. & Buch.).

Only a few specimens of this fish could be examined. According to Day (1) it reaches a total length of 91 cm. Specimens measuring upto 50 cm. were among the samples analysed. Their usual food consists of white bait and prawns as in the other species of Jew fish, but in one instance the stomach

was found to be gorged with shells of *Modiola* sp. The gonads were found to be in roe in July. They are caught in seine net 'Thattu vala'.

6. **Sciaena belangeri** (Cuv.).

The few specimens examined were obtained in the month of March. They ranged from 11 cm. to 17 cm. in length. The food consisted of prawns and larval bivalves. The gonads of the larger specimens were almost ripe in March. They are also caught in shore seines in June.

7. **Sciaena osseus** (Day).

Only immature specimens measuring from 7 cm. to 8.5 cm. were examined. They were found to have fed on prawns.

8. **Sciaena dussumieri** (Cuv.).

The length of the few specimens analysed varied between 9.5 cm. and 11.5 cm. The largest specimen examined measured 30 cm. in length. The main food consisted of prawns and white bait as in other species of Jew fish and they are often caught along with them in the common seine net 'Paithu vala' and the cast net 'Veechu vala'.

9. **Sciaena diacanthus** (Lacép.).

According to Day (1) this species attains a length of about five feet and enters tidal waters. They shoal in fairly large numbers and due to large size and strength, can be captured only in seines made of jute, locally known as 'Vakku vala' which is also used for the capture of large cat fish, *Arius thalassinus*. Hornell (3) mentions the use of harpoons to capture the large Jew fish. Shoals of *Sciaena diacanthus* are observed to follow shoals of *Rastrelliger kanagurta* (mackerel) and on one occasion an entire mackerel was obtained from the stomach of this fish. Being one of the prime food fishes, this fish is in great demand and fetches a good price. The large air bladders are exported for the manufacture of isinglass. Ripe specimens were available in September. The following are the particulars of the roe obtained from the Calicut market on 8-9-'47:—

(i) Length of roe 19 cm.
(ii) Breadth 5.5 cm.
(iii) Weight of roe 445 gm.
(iv) Approximate number of eggs 62,50,000.

10. **Johnius semiluctosa** (Cuv.).

Every year, very young specimens measuring from 2 cm. to 4 cm. are caught in the common seine net 'Paithu vala' along with *Sciaena carutta* in the month of April. A larger specimen measuring 20 cm. was examined in the month of November caught in cast net opposite West Hill. The gonads of a female specimen 26 cm. long, caught in June were found to be well developed. It had fed on phytoplanktonic organisms such as *Thallasiothrix* sp. and *Biddulphia* spp. Partly digested prawns were also found in its stomach.

11. **Umbrina macroptera** (Blk.).

A few specimens were obtained in the months of June and August. They were obtained in the common seine net 'Paithu vala' and the cast net 'Veechu vala'. The size ranged between 11 cm. to 12 cm. Their food consisted of larval bivalves, young prawns, and phytoplanktonic organisms such as *Pleurosigma* sp. and *Fragillaria* sp.

12. **Umbrina dussumieri** (Val.).

A specimen obtained in August, 16 cm. in length, had a variety of organisms in its stomach including polynoid worms probably *Lepidonotus* sp. broken molluscan pieces, hydrozoan colonies, radula of mollusca and sand grains.

13. **Umbrina sinuata** (Day).

A specimen 11.5 cm. long was obtained in the month of December in cast net off West Hill. The sex was indeterminate and the stomach was empty.

THE MAJOR FISHING GROUNDS OF JEW FISH ON THE WEST COAST.

Jew fish was largely caught at Gangoli, Cannanore, Badagara, Quilandy, Calicut, Parappanangadi, Tanur, Paravanna, Ponnani and Blangad.

THE VARIOUS IMPLEMENTS USED IN THE CAPTURE OF JEW FISH THROUGHOUT THE WEST COAST.

Uli, or 'Chattuli' (harpoons) 'Beppu' (large hook and lines.)

Seine nets:

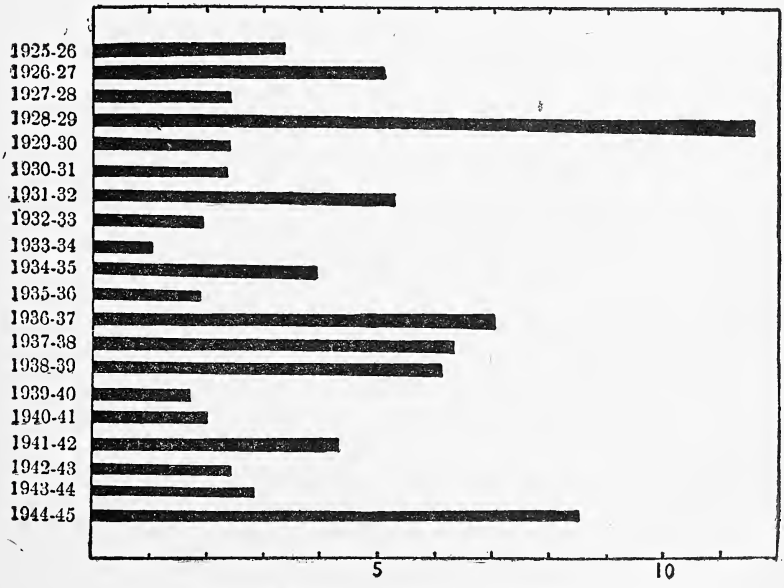
Paithu vala, Peru vala or Mari vala.
Sultan vala.
Nool vala.
Kolli vala.
Vadakkan vala.
Vakku vala (Hemp seine net).

Drift nets:

Kolla vala.
Odu vala.
Kondadi vala.
Ozhukku vala.
Chala vala (Sardine net).
Thirandi vala (Skate net).
Suravu vala (Shark net).

Drag net: Koru vala.
Shore seine net: Rampini vala.
Cast net: Veechu vala.
Hand seine net: (Vatta vala.).

CHART SHOWING THE LANDINGS OF JEW FISH ON THE WEST COAST FOR 20 YEARS 1925-45.



Weight in ten thousands of maunds:

FIG. 1

The fishery shows fairly regular fluctuation. A regular rise in the landings every fourth year is noteworthy.

Summary.

The more important species constituting the Jew fish fishery have been identified. It was also possible to examine a number of specimens of the more dominant species, to discover their main items of food, to determine their probable spawning seasons, to study the various methods of their capture and enumerate the various fishes caught along with them. From the statistics of fish landed on the West Coast, a chart illustrating the landings of the Jew fish for the past twenty years is given. The various fishing methods employed for the capture of Jew fish as well as the main fishing centres of this fish on the West Coast are also enumerated.

Acknowledgments.

I am thankful to all the research workers who worked at the Marine Biological Station, West Hill, during the past decade for the valuable data collected by them on Jew fish fishery which I have incorporated in this note. My thanks are also due to Mr. P. I. Chacko, B.Sc. (Hons.), F.Z.S., and Dr. H. Sreenivasa Rao, D.Sc., F.A.Sc., F.N.I., for going through the manuscripts and for valuable suggestions.

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JUNGLE MEMORIES

BY

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PART I—TIGER.

(With two plates)

'There are more ways of killing a cat,' says the old proverb, 'than by drowning it in cream,' and there are more ways than one of bringing to bag that grand Tom Puss, the tiger. You many beat for him with a line of elephants—a pastime, to use the words of a famous advertisement, 'for Rajahs and rich men only'—or, as more generally practised, with a line of beaters in conjunction with the all-necessary stops. Where beating is not practicable, due either to conditions of terrain, lack of men, or a shallow purse, you may sit up for him, either over a natural kill, or over a young buffalo (dead or alive), or over a water-hole, or on a moonlight night covering a well-known tiger walk. If you are simply a pot hunter, without consideration for the ethics of sportsmanship, you may murder him from a motor car, while he stands gazing at it in surprise or dazzled by its head lights at night. This is much on a par with the globe trotter who bought a tiger in a cage and shot it between the bars in the presence of his Consul, so that the latter could give an affidavit that the animal had been shot in his presence at a range of 5 feet or whatever it was—a yarn which whether true or not, had a wide circulation in Burma many years ago!

But there is yet another method of bringing a tiger to bag which from all accounts appears to be little known—tiger shooting on foot—which affords the greatest thrill of all, and it is mainly with such episodes that the following account is concerned. I am not referring to following up wounded tigers, which is generally done on foot, certainly the most dangerous though at the same time most necessary proceeding which a sportsman can be called upon to undertake, but to the deliberate hunting of unwounded tigers on foot, which for obvious reasons will often include those met by chance. It is grand sport, calling for a cool head and very accurate placing of the first shot, but with those provisos should not entail much more risk than any other form of tiger shooting. There is of course always the chance that the tiger may move just as the shot is fired and the bullet be misplaced, and it was due to that cause that I experienced two regrettable incidents; but some risks must be taken in shikar.

There are several ways in which this form of sport may be practised. You may stalk a pool of water in which the tiger is in the habit of lying during the heat of the day, you may call him up during the mating season, you may still hunt for him in the jungle, or you may stalk him on the open hill-side, and finally you may meet him by chance and not by design. Luck of course bulks very largely

in all big game shooting, and after over 40 years experience I am inclined to agree with a writer who estimated it at 60 per cent, with 30 per cent for bandobust and 10 per cent for straight shooting. In hunting tigers on foot the estimate for luck can be considerably increased.

Memory is notoriously unreliable, but fortunately I have available for reference the shikar diaries which I have kept since 1905, and it is with the help of these, which were invariably written up within 24 hours of the event, that I have compiled the following accounts of tigers shot on foot; in many cases extracts from the diary are quoted verbatim. There is nearly always a lesson to be learnt in tiger shooting, and in each case I have endeavoured to point the moral.

My First Tiger

As it happened my first tiger, and in fact my first head of big game except for a gooral, was shot on foot, though that was by chance and not by design. While stationed with my regiment at Kamptee in the Central Provinces in 1906, I received a letter from a Roman Catholic priest whom I had met, and who lived in a small village in a Bilaspur zemindari, asking me to come and shoot a tigress which was killing a lot of cattle. Ten days leave was obtained, and the train decanted me at Pendra Road station where the Mission tonga was waiting to cover the last lap. On arrival at the village I learnt that a tigress with two cubs lived in a cave about 2 miles distant; she was in the habit of lying in a pool of water during the heat of the day (it was now May), and had demonstrated at some men who followed her up after she had killed a bullock a few days before. The plan arranged was that I should first stalk the pool, and if that failed, should sit up in a machan over the cave with a goat as bait since no buffalo calves were available, and the villagers were unwilling to sell a bullock for the purpose. I set out at 3-30 p.m. and after about a mile of fairly open jungle came across the waterhole but found nothing except fresh pug-marks. I then loaded my rifles, which of course I should have done before setting foot in the jungle, and taking my single barrel Jeffery H. V. ·400 went on, the men following with the goat and my double ·577/·500 Rigby No. 2 Express. After 10 minutes going we topped a slight rise and looked down into a deep nullah with rocky and precipitous sides in the bed of which a lot of huge rocks were piled up one on the other. One of the coolies tapped on a tree with his axe and I saw something dark coloured rush out from the cave below us. I thought it was a hyena, but the headman said it was the tigress. Almost at the same moment the goat let out a piercing bleat, and the tigress stopped about 70 yards away and turned partly round to look back. I rested the ·400 against the side of a tree and fired standing. She did not move to the shot but stood quite still for at least 3 seconds, apparently deliberating whether to charge or not. I did not dare take my eyes off her and was fumbling with the breach of the rifle, trying to get the case out, having entirely forgotten that I had a second weapon. I thought I saw her sway just as she bounded off over the skyline—only a few yards—but could not be sure. The coolies were very plucky and wanted to follow up at once, but I was sure I had

not missed, and had sufficient sense to insist on waiting for a bit. After 40 minutes, as it was getting rather dark and looked like rain, I went along the top of the right side of the nullah, which was some 20 feet high and very steep, and looked across to the opposite side where the tigress had last been viewed, but could see nothing though I used my glasses. I found afterwards that she was lying half way up the opposite side in the open and not 70 yards away. The dry grass was not 18 inches high, but so well did her coat blend with it that we could none of us spot her. Thinking all was clear I went down into the nullah with my No. 2 Express at full cock and the men behind me, and climbed up to the place where the tigress had stood where I fired. I found blood and was looking for the tracks where one of the men who, contrary to the orders, had gone a little way in front and about 20 yards to the right, shouted out 'bagh ata.' All the men at once made for the trees at their best pace, but I caught a glimpse of the tigress lying obviously dead, so called them back. She had tried to climb the steep bank and had got halfway up when she collapsed; a small tree caught her by the middle as she rolled down and held her there. We then retraced our steps out of the nullah and so round to the top of the bank immediately above the tigress, as of course we ought to have done in the first place. She was obviously dead but the men would not go near her till I had pulled her tail. The bullet of 400 grains with ½" lead exposed had entered behind the ribs and passing diagonally through the heart, was found beautifully mushroomed under the skin behind the right fore-arm, in spite of which she had managed to go some 40 yards. While the men were cutting a sapling to carry her, I went down to the cave and looked for tracks—there were no others, so either the story of the cubs was a myth or there was another tigress. I did not wait to see as I was so anxious to get my trophy back. Beginner's luck, with a vengeance! If the tigress had not been dead I should have struck bad trouble with her above me. The lessons learnt then were not forgotten.

Between 1907 and 1910 I bagged several tigers by beating, but my efforts at shooting them on foot were unsuccessful. Both in the Chanda and Raipur jungles I used to spend hours in the middle of a hot weather day stalking pools in the fast-drying river beds in hopes of finding a tiger either in the water or asleep in the shade nearby. Lack of experience and failure to realise how abnormal a tiger's hearing is, were no doubt responsible for my failure. On more than one occasion the tiger had only just left, as shown by drops of water which in that intense heat take only a minute or two to dry. Those were my subaltern days of over 40 years ago when we wore rope-soled boots, not nearly so silent as the crepe-rubber soles of today, and I did not think (as I should have done) of going in stockinged feet. Others have brought tigers to bag in this way, and provided one can stand the heat, it is a method well worth trying, especially in the case of a cunning tiger which refuses to return to its kill or to lie up in ground suitable for beating. But a word of warning is necessary. Unless the first shot is fatal or at any rate disabling, the sportsman, owing to the shortness of the range, may be in for bad trouble. It is extremely difficult to put a satisfactory shot into a tiger, or for that matter into any animal which is lying down,

particularly if in water and so only partly visible. For that reason it is better, after getting into position and ready to fire, first to bring the animal to its feet. A slight noise, such as the tap of a cartridge on the rifle will generally prove sufficient.

A move to Burma in 1911 while affording grand opportunities for sport with elephant, bison, tsine and thamin, gave me no chance at tiger, while the war years prevented all chance of big game shooting. So it was not till I retired and settled down in the Nilgiris that I was able to resume operations against Tom Puss.

The Naragulimund Tiger

My ambition was and still is, to shoot a black panther which I knew might be found in the uninhabited parts of the Nilgiris plateau known as the Kundahs, along the great range of cliffs overlooking Malabar, while there was also a good chance of tiger. Many were the camps I pitched from Nilgiri Peak to Sispara, but though I secured good heads of sambar and Nilgiri ibex no sight did I obtain of a black panther and it was some time before I came across a tiger, though my shikari 'Old Anthony,' who had seen so many tigers shot and was always pointing out places where so and so had met one, used to post me in positions most favourable for observation. And here, both to illustrate the method adopted, and for the benefit of those who do not know the Nilgiris, it will be as well to explain that the plateau, apart from the cultivated areas, consists chiefly of rolling grassy downs interrupted by wooded ravines, locally known as sholas. These sholas which are sometimes of considerable extent, give cover to sambar and tigers during the day time, and it is only during the early hours of daylight or shortly before dusk that one has much chance of seeing an animal outside them—exceptions do of course occur, but generally speaking that is the position. The sportsman therefore takes post sufficiently high to command a wide and general view—if a tiger is seen he stalks and tries to intercept it before it lies up for the day or darkness falls, as the case may be.

But my first meeting with a Nilgiri tiger was not the result of a stalk but my chance. We had broken camp after a blank trip and were marching in from Pirmund to Avalanche—I was with the shikari and gunbearer about a mile in advance of the pack ponies. As we started up the long hill past Naragulimund I heard a sambar ponk at the top, and looking up saw two hinds belling a tiger which was walking down the bridle path towards us. It was about 1000 yards away and I remember thinking it looked like a big striped sausage as it came downhill. It is a sound rule not to fire at a dangerous animal above one, and as the tiger disappeared round a bend of the path, I hurried uphill with the two men so as to command a corner about 100 yards distant and level with us. As the tiger came round the corner I sat up and came into position (I should have done this before) but found that the grass just in front of me obstructed my view so had to take the shot standing. As I fired the tiger, which had halted on seeing us swung round, with the result that the bullet caught him far back. He galloped down into a shola and I gave him half an hour to stiffen. By that time my pack

Photo by H. H. Maharao of Kotah

A tigress changing covert.

The Dodakatte tigress.
" She was a full grown tigress but rather lanky."

Photo by Author

In the Kundahs.
" Rolling grassy downs interrupted by wooded ravines locally known as *sholas*."

ponies had come up with my three dogs, so we put them on the trail. They bustled the tiger into another shola but I could get no shot, so ran up to the top. I could get glimpses of the tiger and dogs below me, but nothing to shoot at, and shortly after he broke across the open into a third shola so closely followed by the dogs that again a shot was impossible—I could however see that he was hit far back. I ran down the hill and up the other side so as to get above him, but after sometime hearing no sound from the dogs and thinking, foolishly, that the tiger had passed out went down to the shola, as I knew that once inside I should have a clear view of at least 50 yards. I was just entering when I heard a growl, and a cry from my shikari whom I had lost sight of and who, unknown to me, was also peering into the shola 50 yards away on my left. I ran round and found that the tiger had bitten him in the shoulder and also practically scalped him. I supported him down to a stream and while I was doing what I could in the way of first aid, the dog boy also suddenly came out of the shola with a bite in the foot and one toe hanging by a thread. My shikari, stout fellow, implored me to follow up the tiger and finish it off, but I would not hear of it and concentrated in getting both men into hospital with the least possible delay. This was done and I am glad to say that both made a satisfactory recovery, though the shikari had a bad time. The tiger died not far from the scene of the accident, but the skin when recovered was too far gone to save. Altogether a bad business, but two lessons stood out—the importance of a deadly first shot and the necessity for keeping together when following up.

The Doddakatte Tigress

In April 1925 I was in camp at Doddakatte, some 6½ miles north of Mudumalai in the Nilgiris-Wynaad. There were a number of wild dogs hunting the valley south of the hut and I was lucky enough to shoot 5 of them in the first two days. But of course they had frightened the chital away on that side and so on the third morning I took the forest path north towards Karaboyee. Within half a mile I came across a small herd of bison but left them alone as the bull was (as is generally the case) a small one. We went on very slowly in hopes of finding a good chital stag, and just as we reached a bend in the path I saw through the thick foliage of the teak saplings something red about 40 yards away. I thought it was a wild dog, but my shikari Kempa said it was a tiger. I could not make out how she was standing so moved forward a couple of yards, when through the leaves I saw that she was facing, while a snarl showed that she has recognised us. Resting my rifle against the side of a sapling for greater steadiness I aimed high on her chest and fired. She dropped to the shot but I could not believe she was dead, so climbed a tree and put another shot into the back of her neck. She was a full grown tigress but rather lanky—a typical game killer. The first bullet had entered at the hollow of the throat and was under the skin half way down the back, beautifully mushroomed—a ·423 soft-nosed. It was just as well that she was laid out on the spot, or a charge would probably have ensued as she was facing us. But ' all's well that ends well ', and I had learnt how deadly that particular shot is.

The Porthimund Tiger

In September of the same year a Badaga came to my bungalow in Lovedale with news of a buffalo killed by a tiger beyond Krurmund, so I took out beaters the next day to try for it. The first beat was blank but as the tiger had fed heavily overnight he was probably still in the vicinity and I decided to try one more beat. The shola to be beaten ran uphill to an open col about 40 yards across, with bare ridges on either side, and another big shola running down behind us. I took up my position in a bush covering the centre of the col—it was high enough to cover my head in front and I cleared openings to enable me to shoot to the right or left. Soon after I was in position I heard heavy footsteps in dead leaves near the edge of the shola in front of me—they moved to the right and then stopped. I guessed it must be a tiger, and was expecting him to come out on that side, but when I next looked to the left I saw the tiger crossing the open not 25 yards away—a wonderful sight with his orange coat glinting in the sun. I raised my rifle (a D.B. No. 2 Express by Rigby) intending to let him pass before firing, but the movement caught his eye and he stopped and stared at me. At such close range a shoulder shot would have meant a charge and his neck was covered, and so I fired at his head. The shot knocked him over but did not kill or even stun him, and he rushed back towards the shola, on the edge of which he fell, followed by an ineffectual left barrel. My first bullet, as I found afterwards had gone below the brain, down his throat and into his lungs, but I did not know this at the time. All I did know was that I must get in another shot before he recovered himself. I ran round in front of my bush hurriedly reloading—and what a slow business it was with an underlever, hammer, non-ejector rifle! I could see a great striped body rising and falling in the shade of the shola not 40 yards away and fired two hurried shots, one at the shoulder which missed and the other at the head as he picked himself up and started to enter the shola—the latter hit behind the ear and finished the business. Though this tiger was shot on foot, I had beaters to drive him out to me, and so strictly speaking this episode hardly deserves inclusion in the series. But I have related it to draw attention to the risk of head shots. Here was a steady shot at close range and I hit exactly where I aimed and yet I failed to brain him, due to the fact that I miscalculated the angle. He was on slightly higher ground than myself—a question of a few feet only—and I thought that if I aimed for his eye I should go above the brain and the bullet possibly glance off. I therefore aimed just below the eye, and the result was that I went too low. Another point worth noting was his noisy progress inside the shola to my right until he evidently spotted the stop in that direction when he retraced his steps absolutely silently, and was in fact half way across the open on my left before I spotted him.

He was a big heavy tiger, well above average, with a very handsome skin, many of the stripes being double, as is so often the case with our South Indian tigers, as compared with the paler colouration and lighter markings of those from the North. A *Royal* tiger, i.e. with an unbroken band of black completely encircling the body, is

however as rare in the South as elsewhere. An unhealed wound along the fore-arm identified this tiger as the one which had fatally mauled a young planter a short time before.

The Bangi Tappal Tigers

In General Douglas Hamilton's book *Records of Sport in Southern India* there is a plate of a family party of five tigers which he saw in the Kundahs near Onnemund in 1867—two full grown and three cubs the size of panthers. It was my good fortune also to meet a family party, though not so large, in November 1926. Tigers are in the habit of coming up from Bhavani and the Silent Valley each year when the N. E. monsoon breaks, and their route is past the Bangi Tappal forest bungalow. I decided to go out there on the chance of intercepting one, and at dawn on the 1st November left my camp at Lakkidi where I halted for the night, en route for Bangi Tappal. We had marched about 5 miles when my shikari stumbled in crossing a stream and pushed the muzzle of the rifle into some mud, completely clogging the bore. At first I thought of leaving it till we reached the bungalow only 2 miles away, not having a cleaning rod with me, but wiser counsels prevailed and I managed to clear the obstruction with the pull-thru weight. As I did so I said to my shikari, 'If I don't clean it now we shall meet a tiger round the next corner'. I little knew how true a prophet I was! We had not gone more than half a mile in the drizzle, when topping a slight rise I saw an animal on the grass by the right side of the path and some 50 yards away—a hurried impression of red gold, black and white showed it was a young tigress. It turned and cantered off and I then saw there were two more (a tigress and a young male) on the left of the path about 100 yards away, also on the move. It was the sight of a lifetime—three tigers cantering over the open grass plain, with their tails stiffly on end. I tore off my rain coat, seized the rifle and ran down the path after them whistling and calling in the hope that they would stand and give a better chance. But I soon saw that they would not stop, so lay down and opened fire at the largest which was going half left towards the long ridge which flanks the path for many miles. I fired four shots but the range was long and constantly increasing—at least one found the mark but failed to stop her and she disappeared uphill into a small shola. I climbed up above it but from the blood marks we could see that she had already passed on into the big shola which ran up almost to the top of the ridge some 600 feet above. I sent the two men down to bring up my waterbottle etc., which had been left behind, and also to intercept my pack ponies when they passed and bring up two more men and the dog, so as to have as many on the look-out as possible. Meanwhile I toiled uphill level with the top of the big shola and sat down behind a convenient bush. I had not been there ten minutes when I saw a second tiger following the line of the first enter the shola far below me—he came at a crouching trot and looked brown with sepia stripes in the dull light. I thought at first of running down to intercept him while still in the open, but fortunately decided to stay where I was. Fifteen minutes later he broke cover and trotted out across the open spur

125 paces below me, with his ears laid back. I fired but missed, and he broke into a gallop downhill making for another shola. Swinging a full length forward I fired again, bringing him head over heels like a rabbit—I had a glimpse of a white belly and hind leg waving in the grass as he crashed into the shola. Exactly where I had hit him I did not know, but it seemed probable that his back was broken. An hour later my faithful retainer Bob arrived with the dog and the other men, and I explained what had happened. We went down very much on the qui-vive to the place where I had last seen the tiger. There was a big trail through the long grass, and the bushes were smashed where he had crashed down the steep bank into a small stream below. A heavy bombardment with stones produced no result, but 'Little Boy', who knew all about tigers, went in and by his furious barking showed us where the wounded animal lay. I moved uphill a short distance and then entered the shola with the men—it was a beastly place with a mass of small hill bamboos and vision was very restricted, but at last I saw a patch of black and yellow in the bed of the stream about 40 yards away. I fired 3 shots but at least two of them were intercepted by the undergrowth, so moved closer, being greeted with growls, and at last got a clear shot which finished him—he was a fine young male and I was glad to have brought him to bag without accident. After a rest we then went after the wounded tigress, but she had got into such terribly thick stuff that it would have been suicide to follow up further, so very regretfully I had to leave her—the skull was brought into me some months later by a cowherd. The last of the family, a young tigress, had gone off to the right of the path when the firing started and we did not see her again, though we heard her calling while we were skinning her brother. I was fated to meet her twice again, but that is another story.

There are I think several points worth noting in this affair: First, it is not worth while to fire long shots at a tiger, especially at one going straight away. Second, the persistence of a tiger in maintaining his original line. Here were three tigers going East—the firing drove them to the West but in spite of that the tiger which I shot resumed his easterly direction as soon as he could. Another point is the importance of having a good dog to locate a wounded animal, which greatly reduces the risks inherent in a follow-up; and finally that while one may stop a tiger by a call before he has seen you, it is waste of time trying this method after one has been recognised.

The Deaf Tiger

In December 1927 I was in camp near Pirmund in the Kundahs. On the 23rd morning I had beaten the sholas near Naragulimund bagging 2 woodcock, and in the afternoon went out to try the ground on the other side of camp. We had no luck with the 'cock but when working a long swamp for snipe my shikari drew my attention to a reddish animal which had just emerged from a shola on to an open grassy spur about 100 feet high and 1,500 yards away. My glasses showed that it was a tiger, and as I watched he lay down on the grass at the top of the spur, which fell steeply to the swamp which we

were working, and looked intently towards us. Leaving the rest of the men where they were, I took the shikari, and moving cautiously till we were out of sight of the tiger, went up the left side of the spur so as to come out on the same level. The last few yards were done very slowly and carefully as I expected to see the tiger at close range, but when we reached the spot where he had been lying he was gone. On our way uphill we had passed along the side of a small shola and though we did not know it the tiger was then coming round the spur below us, though out of sight, and shortly after entered the same shola when we had moved on—the beaters sitting 1,500 yards away had a clear though distant view of all that happened. On reaching the top of the ridge we heard monkeys cursing in the big shola from which the tiger had emerged and thought that he had returned there and might be moving towards the waterfall, so sat down to watch. After 10 minutes as nothing had happened and the light was going I started back to rejoin the beaters using a game path through the small shola which afforded a short cut back. I was wearing nailed boots and almost at once trod on a dry stick which snapped with a certain amount of noise, but I did not trouble about it as it was hardly likely that we would see anything. We had gone about 50 yards when at a sudden turn of the path I saw in front of me what appeared to be a reddish ant-heap only 20 yards away. A hurried glance through my glasses showed that it was the back of the tiger's head with ears cocked forward and a little of the white of the right cheek showing. He was lying in a depression of the path at the edge of the shola, obviously watching the men below. I quickly unslung my rifle and fired at the back of his neck and he fell over on his right side. Calling the shikari I rushed uphill so as to get above him, and then moving slowly forward at last managed to get in a second shot through the heart, but the first bullet had done the trick having smashed the spinal vertebrae. He was a big male but lanky, with a short tail, and while skinning him we found an old wound between the eye and the ear on the left side, from which pus was oozing. There was nothing to show how it had been caused—he may have run on to a spike of wood, or it may have been made by a sambar's horn. But whatever it was, there can be little doubt that the wound made him stone deaf, otherwise he must certainly have heard the stick break only 70 yards away and our approach to within 20 yards—measured next day. Altogether a wonderful piece of luck—first in seeing him, and then in getting such an easy shot. Here also we have another example of a tiger's persistence—he had come out on to the grassy spur for reasons of his own and had been disturbed, but pretty obviously he intended to come out again as soon as the coast was clear.

The Kolaribetta Tiger

On the 3rd February 1929 I was marching in from the Kundahs and at 1-30 p.m. reached Lakkidi, at the head of the Avalanche pass, where I intended to halt for the night. We had scarcely settled into camp when my servant Bob called my attention to a herd of ibex (Nilgiri Tahr) on the slopes of Kolaribetta, a dominant hill about a mile distant. They were too far for me to be sure but I thought

there was a 'saddleback', so after a meal moved up to prospect. Clouds now came down and covered our approach to within close range of where we had last seen the ibex. While waiting for the clouds to lift we heard sambar ponk several times about half a mile ahead of us, and shortly after the sound of a tiger roaring. The mist now cleared and showed the ibex about 200 yards above us—they stopped feeding for only a moment to listen to the tiger which now called again. There was no suitable buck, and in any case a Saddleback was out of the question when there was the chance of a tiger, so we left them and hurried along the cliff face track after the latter. Turning the corner of the hill we spotted the tiger lying in the open on the far side of a big ravine. Only his head and shoulders showed above the long grass, and he was moaning and roaring—evidently calling for a mate—looking down towards the Avalanche river far below on our right. We slipped back out of sight and under cover of a ridge hurried down to get opposite to him. The tiger got up and moved down his spur parallel to us and about 500 yards away, looking a perfect sight with the evening sun lighting up his glorious orange coat and white belly against the green grass. We went downhill as far as a shola which ran up to the edge of our spur, expecting the tiger to cross the ravine and come up by a game path through the shola on his way to Lakkidi, but saw that he intended to cross lower down, so went on again—all this time the tiger was grumbling to himself and seemed very disgruntled. As soon as we were clear of the shola I cautiously came over the crest and sat down—the tiger was now coming downhill opposite me and about 350 yards away—the descent was steep and he never looked up. It was a question which line he would take when he reached the bottom, to his left down the ravine towards the Avalanche river, or straight up to us by a game track which would bring him into view at about 15 yards range as my shikari expected, or to his right into the shola. He had got about three-quarters of the way down when his head turned slightly to his right, and I feared that he was making for the shola and be lost to us, so decided not to wait any longer. He was still coming slowly downhill so I aimed for his nose hoping to get him in the neck or between the shoulders, but I had under-estimated the distance, and the bullet fell short. At the shot he raced downhill to the bottom and turned right across an open space in front of the shola. I stood up, and as he appeared from behind a rhododendron tree about 100 yards below me, fired again. He seemed to lurch, then raced away, and with two great bounds sprang into the shola, followed by a hurried snap shot which obviously missed. After he had disappeared, the bamboos at the edge of the shola, of which I could see only the tops, continued to shake for an appreciable time and I hoped this indicated that he was lying there in extremis, though my shikari was positive that all my shots had missed; the gunbearer was not so pessimistic. We were too far from camp to send for the dogs, so went back up the spur to where the jungle thinned and sat watching, since if unhurt or only slightly wounded he was pretty certain to come out uphill. By 6-15 p.m. nothing had happened and as the clouds were down again and visibility restricted to 30 yards, we returned to camp. At 7 a.m. next morning after packing up and ordering the ponies to wait at

Avalanche, we returned to the spot with the two dogs. On reaching the place where I had fired from we descended to the open patch at the foot of the ravine and at once "Little Boy" took up the scent as far as the bamboos when he backed out barking furiously with every hair up. I should have bombarded the place with stones but was pretty sure the tiger was dead so advanced cautiously. The ground fell steeply to the bamboos and as we reached the edge, my servant Bob who was armed with my 12 bore and Lethals called out that he could see the tiger. It was lying obviously dead in the bamboos with its head on its paws just outside, but to make sure I gave it another shot in the neck. The dogs then rushed in and amid general congratulations, we went down and pulled it out--a fine male. The first bullet had just cut the skin on one fore-paw as it was raised, so must have been pretty close to its nose—the second had gone through the heart and it was doubtless his expiring struggles in order to face round the way he had come which caused the bamboos to shake as they did. Luck-yes! but also the reward for the previous week's hard work without a shot. This may be considered a typical example of tiger-stalking on the plateau, when everything went right. It does not always do so by any manner of means!

The Mudumalai Tigers

Mudumalai, in the low country about 10 miles from Gudalur is one of the best, if not the best shooting centre in the Nilgiris, and for many years has been my favourite hot-weather camp. I have seen more tigers there than in any other part of the district, and the following is the account of some which I encountered.

Having booked the N.G.A. Game Hut for a week I motored down on the 11th May 1933, and in the first three days bagged 2 good chital stags and a pig for the men. As usual there were several tigers about and on the 15th afternoon learning from the Forester that he had seen a tiger that morning on the big fire line towards Kargude, I decided to try for it. At 4 p.m. the usual heavy thunderstorm came up and as soon as it cleared I set out in the car towards Kargude. My luck was in, for as we rounded a bend in the road not half a mile from the Hut I saw a tigress on the road 200 yards in front—she turned and sprang into the long elephant grass on our right. I ran the car up to the spot but there was no sign of her. The question to be decided was whether she was merely crossing the road or coming down it, as in the latter case, bearing in mind the persistence of tigers, there was every chance that she would come out on it again behind us. I ran up the road 50 yards and saw that her tracks were along it so hurried back past the car towards Mudumalai. We had not gone 100 yards when we saw her come out of the grass and cross the road diagonally. I sat down at once and clicked but she was 130 yards or so away and did not hear, so I made a louder noise and she looked round and crouched just as she reached the edge of the road. It was a poor target but I had to take it, and as I fired she moved forward so that my shot if it hit at all must have been far back, which meant a very nasty follow up in the long grass. I drove back to the Hut where

we picked up my second rifle and the dog, and then on foot cautiously approached the scene of the encounter. There was no blood but there were 3 or 4 extended claw-marks which looked hopeful. "Little Boy" took up the trail into the elephant grass but though he hunted round for some time did not give tongue, and though we climbed trees we could see nothing, so gave it up and returned to the Hut, when I arranged with the Forester for the loan of an elephant next morning. My shikari Masty without orders went off at dawn before I was ready and came back with news that he had found the tigress dead. I was so pleased that I dashed off at once with the camera, not remembering till we were close to the place that I had failed to bring my rifle! However all was well—the bullet had as I expected caught her far back and high up, passing through the body diagonally—she had managed to go about 100 yards before collapsing. It was a terrible place for a follow-up and without the elephant, I do not think that we should ever have found her, in spite of the dog's help. That I got a shot at all was due to correct estimation of her intentions.

My old Kurumba shikari Kempa always insisted that the Dipavali festival was the season for tigers' mating, and had promised that if I came down then he would show me a favourite promenade. I was however not able to manage the trip till November 1938, by which time Kempa had died, and I had to engage his younger brother Masty, who though a good shikari was not in the same class with the old man. On the morning of the 3rd November I had been still-hunting towards Doddakatte, during which I had shot a pig for the men, and was on my way back to the Hut. Crossing the big swamp I sat down for a smoke, when Masty who had gone down to the stream for a drink, came back with the news that a tiger had only just passed, and at the same moment sambar began to ponk ahead. We hurried towards them when a reddish lump in the breast high grass caught my eye and my glasses showed the head of a tiger watching us. It was about 200 yards away and I thought that a head shot would be kill or miss so put up the back sight and fired—obviously a miss. The head then re-appeared about 50 yards further on and I had another shot with the same result. On reaching the place we found a young sambar freshly killed and with only one haunch slightly eaten. If I had known about the kill I should not have taken such a long shot but would have sat up—however it is easy to be wise after the event. My driver George, who had not shot a tiger, was very keen to take the chance although the tiger had been disturbed, so after we returned to the Hut and had a meal, I sent him off to sit up. But he wasted a lot of time cutting bamboos and creepers for the machan, and by the time he reached the spot the kill had gone. A search showed that it had been dragged further into the grass and completely finished, not by one but by *two* tigers. So that was that—a good chance messed up!

But as it happened we were fated to meet them again with more satisfactory results. While I was in camp at Mudumalai in May of the following year, we found a sambar kill not 100 yards from the Hut on the swamp side. The guts had been cleaned out and a good deal had been eaten but sufficient remained, so I had a machan erected, and put George to sit up. The tiger arrived at 3-40 a.m.

and was bagged without incident—a fine young male 8′ 5″ between pegs. The encounter with his twin in the following month was more exciting. I had been out all the morning still-hunting up my favourite path towards Doddakatte—there was a tiger about as we could tell by his fresh tracks and the calls of the chital, but we could not contact him. He had gone towards Mudumalai, and when we reached the hut at 11 a.m. I heard monkeys cursing on the other side of the road where there is some thick cover in a ravine—a good lying-up place, but inside the Sanctuary. In the afternoon I decided to take it easy, so sent George off down the Thoraipalli road while I stayed in the Hut. About 6-50 p.m. the monkeys got very noisy again in the same place as in the morning and I also heard a sambar ponk. Taking the spare rifle (George had mine) I went past the car-shed to the edge of the clearing round the Hut, and two minutes later a tiger crossed the path in front of me and only 60 yards away. If I had had my own rifle I could have got a shot, but the spare rifle had a very small back sight and by the time I had got it aligned his shoulders were hidden, so I did not fire. It seemed probable that he would go back up the Doddakatte path, so I ran to the corner and waited there a few minutes, but there was no sign of him. I guessed then that he must have gone down to the swamp and hurried back past the Hut to cut him off. As I came on to the causeway of the Benne road I saw him through the bamboos, with his head down drinking at a pool and only 19 yards away (measured next day). It was now 7-10 p.m. and the light had almost gone, and to align the sights I first had to raise the rifle to the sky to get the bead into the notch, then lowered it and fired at his shoulder. He sprang into the air with a 'wuff' and all four feet off the ground, having in some extraordinary way turned completely round, and as it was nearly dark I waited to see no more. Once before I had seen a panther bound into the air and reverse in this way and that panther was hit far back and had gone some little way before we found it dead next day, so I was not at all sure whether this would not prove a similar case. But a cautious approach at dawn showed him lying dead in the pool, the bullet having passed through the heart and mushroomed nicely under the skin on the far side in front of the shoulder. I took a big chance firing at him at all at such short range in failing light, but it was not to be resisted, and after all one must take *some* chances in big game shikar. My diary records that while drinking he looked an extraordinary sight, just like a great black and white frog. If I had not been looking for him I doubt whether I should have seen him at all in that light. The lesson to be learnt from this episode is that it pays to investigate alarm calls in the jungle.

One more incident will suffice for the Mudumalai tigers. In May 1948 I was returning from my favourite round and taking a short cut back to the Hut across the swamp. As we reached the latter I saw a fine tiger passing us across the open grass about 200 yards away, moving steadily forward with his head down. We were in shoulder high grass and I hurried forward under cover to try and get closer but he was going too fast, so I withdrew and made a quick circuit to get ahead of him but we never saw him again. I do not think he saw us and probably he had a place to lie up in the thick cover which we skirted. In the month following I was down at

Mudumalai again and the first morning left my driver with the car at the Honurhatti cross-road as we were short of trackers and there was no one to accompany him. He saw a tiger come out on to the road 200 yards away and walk steadily towards the car which was parked in the jungle and to some extent concealed by young growth. Not till he got within 20 yards of the car did the tiger spot it when he stopped, had a good look at it and then quietly withdrew. George noticed that he held his head low as he came along and I have not the least doubt that it was the same tiger which I saw in May. The swamp where I saw him then was only 400 yards behind where the car was parked and he was making in that direction. My driver thinks that the tiger never spotted him at all, as he sat motionless but that his attention was focussed entirely on the car, which I think very probable in view of a previous experience related below. The episode also shows how tigers are inclined to stay on in one particular locality, and that only perseverance is needed to contact them.

The Tigress and the Car

In December 1940 I had come up to my home in the Nilgiris on 7 days' leave, and on the 26th determined to run down to Anaikatti to revisit old haunts, which owing to war service I had not seen for some time. We left at 6-30 a.m. with the hood down for better visibility and were glad of our warm coats in the freezing cold. Reaching the foot of the Sigur ghat at 7-10 we turned to the right and motored slowly along the forest road. It was still a bit early for jungle-and peafowl to be out and we saw none. Passing the temple of Sokanhalli I noticed fresh tracks in the dew on the short-cropped grass and wondered what animal had made them. We were soon to know, as half a mile on, out of the spear-grass which here covered the centre of the track, and not more than 70 yards away, rose the form of a tiger, which without looking back, walked into the jungle at the side of the road. One would have thought that such a large animal would have been visible in grass not 6 inches high before it rose, but apart from the protection given by immobility, was the protective colouration of the tiger's coat which exactly matched the dead spear-grass. As it walked away I noticed how dark it looked, as usual when tigers are viewed going away—almost brownish—with the tail carried in a low loop. I stood up in the car hoping for another view as we ran up to the spot where it had disappeared and found that we were at closer quarters than expected, for there only 10 feet away (measured afterwards) was the great black, white and orange head peering in a surprised way out of the grass and bushes which lined the road—she was lying down and only part of the body was visible. Her eyes at first showed puzzled curiosity and I think there can be no doubt that she was looking at her own reflection in the polished side of the car, as one so often sees in the case of dogs. Then she looked up and her eye met mine, and with a snarl and a huge spitting 'Ha' she turned and was gone. It was lucky that none of us made an indiscreet movement at such close range, as I should certainly not have had time to fire if she had turned nasty. The episode was an extremely interesting one, and shows not only that tigers have a great vein of curiosity,

but also that, contrary to popular opinion, they are not aggressive even at close quarters provided one makes no move. The beast in question was a young tigress but full-grown.

The Kolimund Tigress

The scene now shifts back again to the Nilgiris plateau. I have already related how I met 3 tigers on the path near Bangi Tappal in 1926 and how the young tigress escaped unfired at. She stayed on in the vicinity and as she grew older gave a lot of trouble killing cattle and buffaloes from the herds brought up to pasture in the dry season. I came across her once in 1928 beyond Nanjamund, some 3 miles from Bangi Tappal, when I missed a difficult running shot, and during the following years sat up several times over buffaloes which she had killed, but without success. In May 1933 she stalked my pack ponies at Bangi Tappal just behind the bungalow, but a *pheall* cry gave us warning and they were rounded up in time. But the sands were running out and in October of the same year we had our final encounter. At the time I was in fishing camp at the de Heriez Hut on the Billithadahalla, and on the 13th having noticed the tracks of this tigress about 2 miles away from the bungalow, I gave strict orders that the ponies should be tied up at night, in the stable. However this was not done, and when my servant called me on the 14th morning he said that one of the ponies was dead and had apparently been killed by a tiger. I went out on to the varandah and saw the pony lying in the open 100 yards away across the ravine. My shikari who was examining it called out that a tiger had killed it and that its foal also was missing. After breakfast I took my rifle and 2 men and inspected the kill; the large fang marks showed that it was the work of a full-grown tiger and a few yards away a pool of blood indicated where the foal had been killed. There was no sign of the latter and the long grass afforded no pug marks but I guessed that it had been taken uphill into a small shola which we proceeded to search but without result. I then went uphill, and 'Little Boy' who had got the line and gone ahead over the top, suddenly came running back, barking furiously and looking behind him. There could be no doubt that the tigress had only just gone—probably she had been lying in the grass at the top watching us, so we hurried up but could see nothing. The dog took the line some way up the valley and then lost it, but I was pretty sure that she would make for Kolimund, to lie up in one of the big sholas there, so we carried on. After half-a-mile or so the valley forked—right to Lingamund, centre to Woodcock Shola, and left to Kolimund; there were no pug-marks at the crossing so I continued left towards Kolimund. Five minutes later we were rounding a spur when I saw the tigress on our left about 300 yards away cantering down the open slope, having cut across the corner of the valley. I do not think she saw us, as she broke into a walk on reaching the shola and entered it without looking back. The shola was a long narrow one running about 400 yards uphill—at the botton a stream fringed by small trees came down from another small circular shola on a steep slope on our right—this small shola was to be the final scene of operations. Our object was to keep the tigress from breaking out

to the left where she could easily reach the big sholas beyond Kolimund and be lost to us, so as a first move, I sent the two men up the open spur on the left of the shola with orders to shout while I covered the angle between the two sholas, but nothing came out except a jungle sheep which went over the crest of the hill and which at first sight I thought was the tigress. The latter had evidently made up her mind to lie up, so I sent one man back to the bungalow to bring all available men (there were only three) while my shikari watched the top of the big shola and I moved up above the small one—we thus commanded the whole area and it was impossible for the tigress to slip out unseen. The beat was to be down hill with the right leading so that the tigress would either break across the open spur, which was unlikely, or more probably come out at the bottom along the fringe of trees and up through the small shola. I therefore selected a spot on the spur covering both lines and about 130 yards from where a game track emerged on to the col from the small shola. Knowing how keen a tiger's sight is and as my position was on the bare hillside, I pulled up some grey bents growing on some rocks nearby and built a small wall 18 inches high to cover myself, and also put some of the same on my topi. About 10 a.m. the men arrived and the beat commenced, and for some 10 minutes nothing happened. Then I saw the tigress standing on the col at the far side of the small shola looking at me, evidently uncertain what I was. She was partly hidden by the grass and low growth and was 180 yards away—a good deal further than I expected. My sight was set for 100 yards only, so I aimed extra high on her shoulder and fired. She fell and rolled about and gave me time for a second shot, which however struck short, as I had forgotten to aim high the second time. She then got up, bounded in my direction a few yards, then turned to her left and sprang into the shola. I called up the men, and after an interval we proceeded to the spot and sent the dog in. We soon heard him barking furiously and then growls, so it appeared she was still alive, and as the undergrowth was very thick I decided to leave her till the morrow. Next morning the same barking and growls occurred when the dog went in, but I could wait no longer as I had to return to Ooty. As a first move I had a lot of stones collected and the place well bombarded, but without eliciting any response. The shola was only some 50 yards through on a steep slope, and from the dog's barking it appeared that she was lying at the bottom just inside the bushes. Nothing could be attempted from below except by a suicide squad, so we entered the shola at the top and I covered two men while they climbed trees. Sending in the dog again gave us further confirmation of the tigress's position, and the men were able to move forward from tree to tree without coming to the ground till at last the shikari spotted her and with my permission fired a Lethal bullet. But she was dead, lying in a little hollow which almost completely hid her. My first bullet had smashed one shoulder and gone through the heart, and yet she had lived to roll about, bound forward as if untouched and then spring into the shola. The growls we heard were evidently made by 'Little Boy' who had worried a piece of skin of the stomach—he must have thought us queer people to leave her the day before. If only dogs could talk! This was his 8th tiger—apart from one which he chased

out of a shola while we were beating for woodcock near Avalanche —and proved to be his last, as he died while I was in England in 1934, a sad loss as I found to my cost later in the same year. Till he was gone I did not realise how much I relied upon him. The tigress was of course 'frozen' stiff so her measurement of 8′8″ between pegs was certainly several inches less than it would have been if taken immediately after death—as soon as I saw her pads I recognised our old friend, who had given us the slip so often, and had caused such destruction among the Badagas' herds.

Apart from the importance of having a dog to follow up, I think the chief lesson from this episode is the necessity for having some cover, however slight, if one is posted on a bare hill-side. Without it I should probably not have got a shot at all, certainly not a steady one.

The Bison Swamp Tigress

Man-eating tigers are almost unknown in the Nilgiris but during 1933–4 a tigress was reported to have killed and eaten 8 persons near Attapadi in the upper Bhavani valley. She was said to be a big beast in the prime of life, but with one canine tooth missing.

My shooting hut at Bison Swamp overlooks the gorge of the Bhavani river and is an excellent centre for sport. Old shikar books record the shooting of both elephant and bison there, but nowadays elephants visit only occasionally the most distant parts of the Kundahs round Angindamalai, while bison are practically unknown on the plateau, though I did find the tracks of a big solitary bull near Bangi Tappal in 1935. Bison Swamp is however still good for tiger, sambar and Nilgiri ibex, while several black panthers have been shot there. It was more especially for the latter that I camped there in April 1933 but without success. There was however a tigress about and we were constantly coming across her tracks and heard her calling on several occasions. One evening she followed us right back to the hut, though we did not know it till we saw her tracks next morning, but finally we had to leave without sighting her. At Christmas 1934 I camped at Billithadahalla for several days and then moved across to Bison Swamp. On the afternoon of arrival, wanting some meat, I went out with my shikari to the head of the valley to try for a jungle-sheep. I took my ·318 only as I did not expect to see anything else so close to the hut. I had been sitting by the edge of a shola some time watching the open ground when I heard heavy footsteps inside the shola. They reminded me of those made by the Porthimund tiger before he came out, but we had seen no fresh tracks of tiger and I had no reason to suppose there was one in the vicinity. As the light began to fail I started back for the hut cutting over a spur, and had scarcely reached the top when my shikari pointed out an animal sitting up on the top of the main ridge some 300 yards above us; my glasses showed that it was a tiger. To fire at a dangerous animal above one is generally asking for trouble, but in between there was a deep wooded ravine—the light had almost gone but I knew that the telescopic sight would give sufficient illumination, while I had the utmost confidence in the accuracy of my ·318, though I had never used it before on dangerous game. Sitting down quickly, I therefore fired a steady shot at her

chest, but whether she rose at the moment or whether I underestimated the distance, the fact remains that she did not fall to the shot, but came roaring down the hill towards us, finally crashing into the wooded ravine which lay between. The light was now gone, so nothing more could be done for the present and we returned to the hut. At dawn next morning we went to the top of the ridge and followed the trail down to the shola. A bombardment with stones having elicited no response and the ground being in our favour, we then entered the shola and continued the search. There was a copious blood trail and we also found at intervals large pieces of gut, so that although obviously hit in the stomach it did not appear likely that she could go far or survive long. Not having a dog our progress was slow, but by 1 p.m. we had searched three sholas without result, though we did find the very smelly remains of a sambar on which the tigress had been feeding in the shola outside which I had been sitting on the previous evening—so there was little doubt that the footsteps I heard were her's. An injured knee was now becoming increasingly painful and as we were all feeling the strain, we returned to the hut for food and a rest. About 2 p.m. Jogi, the game watcher from Billithadahalla, who had been in at the death of the Kolimund tigress turned up, and learning what had happened and that I was too lame to go out, he volunteered to go and search the one remaining shola, with the shikari and gunbearer, who were positive that the tigress must now be dead. I absolutely refused and said we would leave it till next morning by which time I hoped that my knee would be well enough for me to accompany the party, but after further discussion very weakly gave way. I insisted however that they should work the shola from the top, that they should all keep together, and that my driver George should accompany them with my 12 bore and Lethal bullets. If they found the tigress still alive, they were to send for me at once and I would get out somehow. An hour after they had left, George came running back to say that they had found the tigress alive and that she had killed Jogi. Getting on one of pack ponies I went out to the spot. It seems that while the rest of the party were negotiating some difficult ground, Jogi had, against their advice, gone on in advance and found the tigress lying under a fallen tree. She came towards him slowly, but instead of hitting her with his axe, he retreated and fell backwards over a bush, whereupon the tigress gave him one bite on the thigh and left him. There were only a few drops of blood, so the femoral artery could not have been severed, and it appeared that the poor fellow had died of shock. The tragedy necessitated a return to Ooty, and it was not till 4 days had elapsed that I was able to visit the spot again, when we saw 2 jackals slink out of the shola and guessed that the tigress was dead. But I was not taking any chances and we moved down into the shola in a compact body with the 2 guns leading. We found her dead near some water about 50 yards lower down, and a further search showed that she had been lying for some time under the bushes close to the scene of the fatality and must have been watching us while I covered the men who removed the body, though I could see no sign of her. She was a big tigress, considerably above the average, and I noticed one canine tooth was

missing. Whether she was the Attapadi tigress or not can never be known, but from that date onwards there were no further reports of human kills in that area.

Even after the lapse of years the memory of this tragic episode is distressing and I would willingly have omitted it, but for the lessons which it embodies. And to my mind the first and most important of these is that one should not fire long shots at a tiger with a light rifle. Another is the importance of having a dog to locate the wounded animal, and finally that one should never send men to search for a tiger, even though you believe it to be dead or at any rate incapable of mischief, without accompanying them oneself. However detailed may be the instructions which you give, there is always a risk of their non-observance as happened in this case.

The Mukerti Tigers

On the 3rd May 1943 having obtained a few days leave I was in camp at the Mukerti Hut half way up the east side of the lake. I had intended to fish but conditions were hopeless, so I decided to try for a black panther which had been missed by another sportsman the previous month, and which was said to be still in the vicinity. About 4 p.m. we went back along the path for about half a mile to the old buffalo kraal and I then worked up the big spur of Pichukal-betta Hill to a convenient position, so that I could overlook the whole valley with its several sholas, and cover a good game track favoured by tigers just below me. In my rear was the Mukerti Lake now some 20 feet below level, and dead still save for an occasional ripple, and on my left front some 1,500 yards away a freshly burnt round knoll above which was the shola leading to the col where I had shot the big Porthimund tiger in 1925. Several lots of sambar appeared with one small stag, most of them making for the knoll—where the young green grass was an obvious attraction. I heard monkeys cursing in the big shola just short of it, and twice a sort of moaning noise which sounded somewhat like a faint tiger call. But nothing further materialised except that a black monkey came out of a shola on to the grass some 300 yards below us and stayed for some 10 minutes—I hoped at first that it was the black panther, but no such luck! and so at dusk we gave it up and returned to the hut.

At 4 p.m. the next day we went again to the same spot, and at 5.30 I saw an animal going diagonally up the slope of the round knoll, and as it did not look quite like a sambar, I got my glasses on it. It was a tigress with her magnificent black, orange and white coat standing out in splendid contrast to the green grass. She seemed uncertain what to do when she reached the top, first going towards the shola beyond and then returning—finally she lay down among some small rocks looking towards us, having possibly seen my shikari who was further up the hill, coming down to join me. Though I had only the ·318 with me I decided to go after her but determined on no account to fire unless I got a steady shot at close range, so we started down the spur in full view of her, but some 1,500 yards away—I did not think that at that distance she would be able to make us out. We had not gone far when my shikari said

there was a second tiger, but my glasses showed a cub on each side and a third scrambling up the slope towards her. They were not much bigger than jackals, so of course I gave up all ideas of shooting and sat down to enjoy the wonderful spectacle till she passed out of sight over the knoll.

Some months later she moved over into the Avalanche valley where she was fired at and missed, but one of the cubs was shot—she then returned with the remaining cub to the Krurmund-Mukerti area, and in November 1945 I saw her one morning not far from where we had first sighted her. She was coming down an open grassy slope about 800 yards away and did not emerge from the shola at the bottom so obviously intended to lie up there. By 4 p.m. we were in position covering the probable lines of exit, George being some way uphill of me. An hour later the tigress came out below him at pretty close range, but he did not allow for shooting downhill and the bullet went over. She rushed on and into the shola just below me, though not in view, but shortly after came out again with her tail on end and evidently looking for trouble. George made no mistake this time and dropped her on the spot, the range being about 80 yards. When we went to skin her next morning we found that the cub, now almost full grown, had been lying all night in the grass close to the body, as we could tell by the hairs left in the dry form. The episode contains no particular lesson, but is related as of general interest.

Calling Up Tigers

Personally I have no experience of this method but there is no doubt that it can be practised with success. A friend has described to me his experience in the Anamalais many years ago, when a tiger was heard roaring and his shikari began to call it up. My friend at that time knew little about shikar and could not speak the language, so failed to realise what the shikari was doing, and got the shock of his life when a large tiger suddenly materialised at close range—he was in fact so flabbergasted that he fired blindly and missed!

Another friend has by the same means brought several tigers to bag in the Mysore jungles and has stressed the importance of being well concealed and of being ready to fire quickly at very close range. The method employed is oral with the hands cupped round the mouth—whether a different tone has to be employed according to the sex of the animal I do not know. I have also seen a small earthenware chatty with the mouth tightly covered with parchment. A waxed cord passes through the middle of this and out by a small hole in the base of the pot. By drawing the cord to and fro an excellent imitation of a tiger's call can be produced, and it is said to be quite effective in calling one up, but as I said before I have no personal experience of either method.

Conclusion

These jungle memories of some tigers which I have met have been narrated not as an unvarnished record of slaughter, but in the hopes that the lessons to be learned from the various episodes may prove

of benefit to others who may have the good fortune to indulge in this particular form of sport, the grandest which India—that land of happy memories and to whom I owe so much—can offer. There are many good books on Indian shikar which give full details of the procedure for beating or for sitting up for tigers, but for some reason the subject of tiger shooting on foot has received very little attention. The difference lies chiefly in the need for quick decisions. When beating one has ample time to select trees for the machan and for stops, and when the tiger does appear it is not generally necessary to take an immediate shot. The same applies to an even greater extent when sitting up. But when shooting tigers on foot the encounter will often be at close range, and a split-second decision is necessary if success is to be achieved. Risks have to be taken as in any kind of sport, but they can be minimised by going about things the right way and by learning from the mistakes of others. There is nothing new in the lessons which I have tried to bring out, but I hope that this narrative will show how they can best be applied in practice, so that other sportsman may avoid the mistakes which I have made.

Note.—'The Deaf Tiger' first appeared in the *Indian State Railway Magazine*, and is reproduced by kind permission of my collaborator Major F. Murcutt ('Fred Barrie') and the editor of that journal.

(To be continued)

A NOTE ON THE FOOD HABITS OF THREE KINGFISHERS OCCURRING ON SINGAPORE ISLAND

BY

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(*With 2 text figures*)

Early this year I began a comparative study of the food habits of several groups of nearly related Malayan birds. Pressure of other work forced the abandonment of this project in its original form. In view, however, of the limited number of detailed observations available on even the commoner species, it would seem to be of interest to record here the data collected in the case of three of the kingfishers.

The work was prompted to some extent by a consideration of the contention of Gause (1934) that two species with a similar ecology cannot live in the same area, and the subsequent examinations by David Lack (1944 and 1945) of the habits of closely related passerine and non-passerine birds in Britain and on certain oceanic islands. Lack in particular gives a number of cases in which members of a genus occupying the same geographical area show different diet, feeding and nesting preferences. A further study of the principle at issue is recommended to those members of this Society who have opportunity and time for detailed field work.

Alcedo atthis bengalensis Gmel. Indian Common Kingfisher.

This bird is undoubtedly resident on the island of Singapore, but the numbers are very much increased in the autumn and winter months (from late September to March or early April), and it is only during this period that it can really be considered common. It is nearly always encountered over water, or in its immediate vicinity. It is most numerous in the coastal areas, in the channels through the mangrove belt, over the prawn and fish ponds towards the west end of the island, or more rarely on the shore itself. It also occurs, though less frequently, by freshwater further inland, and I have seen it over both streams and ponds. At the beginning of 1942 two birds were apparently resident at a disused brick-clay pit, which had filled with water.

The Common Kingfisher generally perches on a stump, branch or post overlooking water, and obtains its food by plunging down suddenly, after a long period of careful watching. It normally continues its flight in an almost straight line, and after rising from the plunge settles on a further stump. The food is usually carried in its bill, and swallowed after alighting. Fish are generally held crosswise while it is in the air, and then turned so that they go down head first after the bird has come to rest. Often this is achieved by a gulping action, but occasionally they are thrown

up a few inches and then caught by the head as they fall. If still very active they may be beaten several times on the bird's perch to quieten them before they are swallowed, much as I have seen cormorants hitting large eels on the surface of the water off the British coast. More rarely *bengalensis* feeds by swooping in a similar manner over exposed mud-banks or muddy beaches, when the tide is low. On two occasions I have seen it making a vertical plunge into water, from a height of about fifteen feet, after hovering for a short time.

It is interesting to note that when feeding in streams or very small ponds these birds are often seen alone or in pairs, and they appear to resent the intrusion of others of their species. During the winter months on the open prawn ponds, on the other hand, there may be as many as eight birds working an acre of water, apparently amicably. Possibly the stream birds are in the neighbourhood of their nests, and it is breeding rather than feeding territory that is being defended. Alternatively the apparent toleration shown on the open ponds may be due to a high proportion of immature birds, which have not developed fully a quite reasonable reluctance to being hemmed round by their fellows.

By bulk the diet of birds feeding in the mangrove areas appears to consist largely of small fish, 25-45 mm. in length. They also take a number of rather shorter prawns. The stomach from a representative example collected at the Pasir Panjang ponds contained two fish, partially digested, or about 30 mm. length, the greater part of the chitinous portions of a prawn, and the lenses from the eyes of a further two fish. The latter appear to remain in the stomach long after everything else has disappeared, except possibly for a few indeterminate bone fragments, a common finding in sea and coastal birds (Gibson-Hill, 1947). When feeding over muddy beaches this kingfisher takes mostly small mudskippers, *Periopthalmusdschlosseri* Cantor, and fiddler crabs. Five birds examined on Singapore Island in October-November contained nothing further that was discernible.

Birds feeding over inland streams appear to take anything of an animal nature that they can find alive in the water. An example collected in Selangor in May contained a dragonfly larva, two water beetles and the remains of a small fish, while a second from the same area had the remains of what appeared to be several tadpoles. An inland bird from the Bukit Timah area on Singapore Island, examined in November, contained a small fish and four Neuroptera larvae.

Alcedo atthis, in its nine subspecies, has a wide range over Europe, North Africa, Asia and the islands of the south-west Pacific. The feeding habits and diet of *A. a. bengalensis* as observed on Singapore Island and in Selangor would seem to be very similar to those recorded for the species in other areas. Probably the most complete summary is that given for the Western European race in volume 2 of the *Handbook of British Birds* (Witherby *et al.*, pp. 273-274). The latter quotes green water-weed as present in the castings; one would suggest that it had probably been taken in error, particularly as it must have proved largely indigestible.

Halcyon smyrnensis fusca (Bodd.) White-breasted Kingfisher.

This bird is resident on Singapore Island, and both plentiful and conspicuous in suitable areas. It is usually found in gardens, orchards or similar patches of open countryside, and it is rarely seen over or close to water. It is relatively scarce in the mangrove belt or other extreme coastal areas.

Its manner of feeding is rather similar to that of the preceding species. It makes a sudden swoop downwards from a vantage point at a height of ten to twenty feet, carrying on after striking at its prey to alight on a further, similar perch, where the food is swallowed. It differs in that it almost invariably works over dry ground. I have never seen it take food from water, and only once from a mud beach.

The principal constituent of its diet on Singapore Island is undoubtedly insects, mostly grasshoppers and other orthoptera. Often these are taken in the larval stage. It also eats a number of lizards, chiefly skinks. I have found remains of the latter suggesting total lengths up to about 125-150 mm. I also once watched a bird battling with, and eventually swallowing, a green lizard, *?Calotes cristatellus* Kuhl, fully 350 mm. long, including the tail. Lizards at least appear to be turned and swallowed head-first, as *bengalensis* swallows its fish. This species also takes young or small birds: while interned in Changi jail a group of us watched one attack and swallow a sparrow fledgling, barely able to fly, and make a determined though unsuccessful attempt on a second.

In all eight stomachs were examined, six on Singapore Island in June, August and October, and two in Selangor in May. These yielded the remains of three skinks, *Mabuia* sp., probably *M. multifasciata* Kuhl, feathers and the head of a *Munia* sp., some fifteen grasshoppers of varying size, a 65 mm. Mantid, four beetles, three bees, four large black ants, a small scorpion, *Isometrus maculatus*, and two centipedes, *Scolopendra subspinipes*. There were also a number of insect remains not identifiable, but no traces of fish or crustacea. The three bees and the four large ants were all in one stomach, together with a few further well-digested insect fragments, which may have been the remains of crickets. The large Praying Mantis, *Hierodula ?venosa* Oliv., was alone, and seemed to be providing a meal in itself.

Halcyon smyrnensis, in its five subspecies, occurs across the whole length of southern Asia, from Asia Minor to the Philippines. The examples examined on Singapore Island and in Selangor were all feeding on purely terrestrial animals—mostly insects, and to a lesser extent other arthropods, lizards and small birds. This agrees in general with the findings of Stuart Baker (1927, p. 270), Robinson (1927, p. 97), Delacour and Jabouille (1931, p. 319), Smythies (1940, p. 289) and Sálim Ali (1941, p. 214), except that Stuart Baker, Delacour and Jabouille, and Robinson include crustacea and fish as possible items.[1] It definitely does not conform to the

[1] 'Its principal articles of diet are undoubtedly grasshoppers and locusts, but it will eat almost any living thing not too large to swallow. Frogs, small lizards, worms, etc., are all thankfully taken and eaten; I have seen it taking

observations of Delacour and Mayr (1946, p. 136) for *H. s. gularis* (Kuhl) in the Philippines, of which they write, 'The name kingfisher seems more appropriate to the White-throated Kingfisher than to any other member of the genus *Halcyon* in the Philippines'. Oddly enough these authors quote as a diet for *H. chloris collaris* (Scop.) a menu that would seem more fitting for the present species—'. . . feeds mostly on grasshoppers, lizards and crustaceans, but in the Philippines is also reputed to catch fish'. (ibid, p. 135).

Halcyon chloris humii Sharpe White-collared Kingfisher.

This bird again is resident on Singapore Island. It is almost as plentiful as the preceding species, but it is largely confined to the mangrove belt and immediate coastal areas. It may occasionally be met with inland, but I have not seen it feeding away from the vicinity of water.

Its method of obtaining food is similar to that of the other two birds, but it generally feeds over exposed mud flats and mud beaches. It may frequently be seen perched over water, apparently watching it intently, but I have only twice seen it actually swoop down, and on neither occasion did it appear to have been successful. On the other hand, I have several times seen it perched on fallen trunks, and seemingly pecking at small crustacea moving over them.

Six stomachs were examined, all on Singapore Island, in August, September and October. One was empty. The other five contained only the remains of six small crabs, fiddlers and others, one prawn, two mud-skippers, *Periopthalmus* sp., and three large larval grasshoppers.

Halcyon chloris, in some forty-seven subspecies, occurs across southern Asia from the Red Sea coast eastwards, and out over the islands of the west and central Pacific. The examples examined on Singapore Island were all feeding in the mangrove belt, or on adjacent beaches—taking mostly crustacea, and to a lesser extent fish and orthoptera. This agrees in general with the observations of Stuart Baker (1927, p. 276), Robinson (1927, p. 101) and Delacour and Jabouille (1931, p. 323), though the last two include

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cicadae from the trunks of trees, whilst prawns, small crabs, etc., are taken in preference to fishes when it hunts streams'. (Stuart Baker, 1927, p. 270).

'The diet is largely small crustacea, lizards, large insects, etc., and less purely fish than the smaller members of the family'. (Robinson, 1927, p. 97).

'La majeure partie de sa subsistance consiste en sauterelles, en cigales, en petits lézards, grenouilles, vers, puis en petits crabes qu'il poursuit, de préférence aux poissons, dans les petits cours d'eau'. (Delacour and Jabouille, 1931, p. 319).

All the additional items given by these authors are compatible with the observations made in Malaya, except for the prawns and the fish. Since these birds appear to confine themselves fairly strictly to living matter, this must mean that they do occasionally feed from water, a habit which I have not yet observed personally. It may, of course, be that this occurs in areas more thickly wooded than those in which I have watched them, where water provides the greater part of the clear spaces in which they can hunt.

small reptiles.[1] This is by no means inconsistent with the findings outlined above; the difference between a shink and a mud-skipper

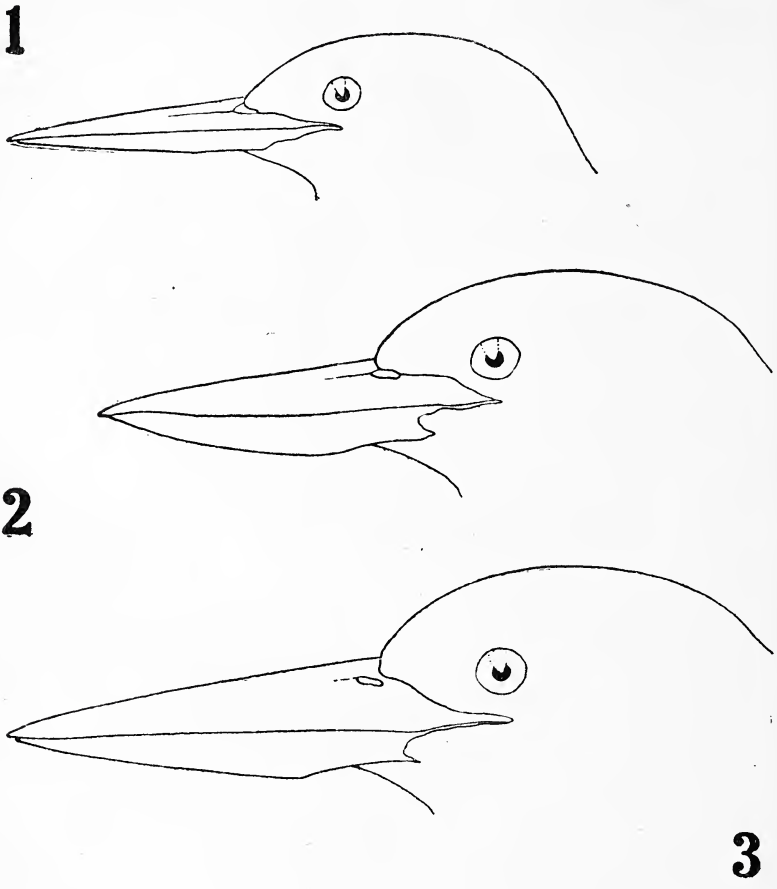

FIG. 1

Outline drawings of the heads of the three kingfishers discussed in this paper: (1) the Indian Common Kingfisher, *Alcedo atthis bengalensis*, (2) the White-collared Kingfisher, *Halcyon chloris humii*, and (3) the White-breasted Kingfisher, *H. smyrnensis fusca*. All three drawings are about life size, and represent female birds taken on Singapore Island.

must, to a bird, be of little consequence. Mayr (1945, pp. 240 and 243) suggests by implication that the five races occurring in the Solomon Islands have feeding habits similar to those of shrikes

[1] 'Their food consists largely of small land-crabs, but they also feed on grasshoppers, insects, small reptiles, etc'. (Stuart Baker, 1927, p. 276).

'Sa nourriture consiste surtout en petits crabes terrestres, et également en sauterelles, insectes divers et petits reptiles. Il ne s'éloigne pas de la mer'. (Delacour and Jabouille, 1931, p. 323).

The first sentence of Delacour and Jabouille reads, as a number of their comments do, very much like a translation from Stuart Baker.

and flycatchers, but this is obviously not a final statement on the subject.

Comparative Note.

The last two species are in many respects very similar to each other; the first is closely related to them. In broad outline the three birds employ the same manner of feeding, but on analysis they would seem to be operating in rather different fields. *Alcedo*

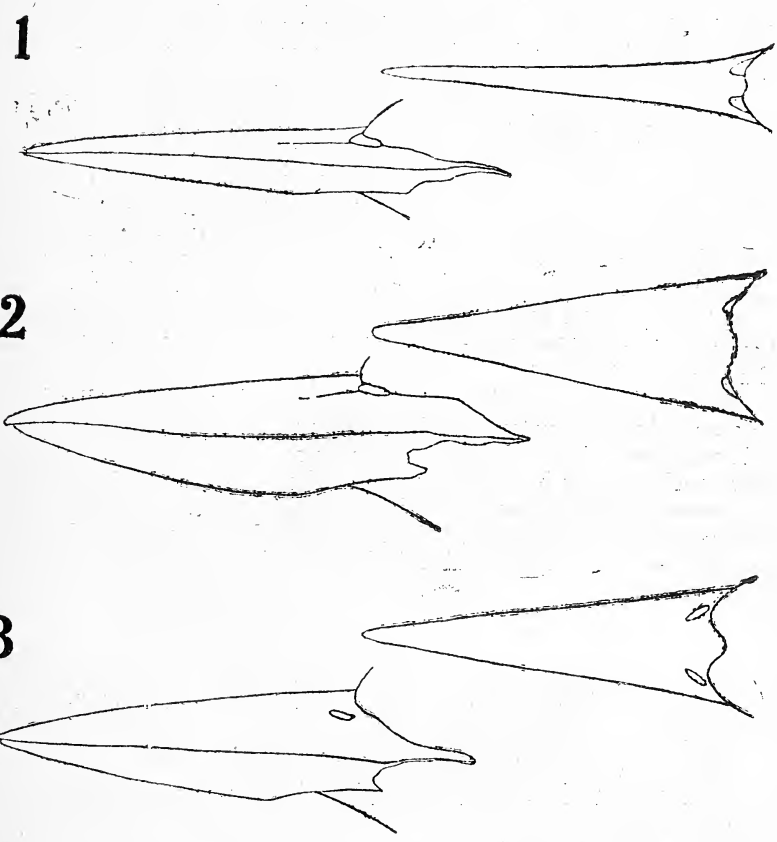

FIG. 2

Outline drawings of the bills of the three kingfishers discussed in this paper, on the right from above, and on the left in profile. The scale has been varied in preparing these drawings so that each bill is represented with the exposed culmen about 2 inches long. The birds, all adult females taken on Singapore Island, are (1) *Alcedo atthis bengalensis*, (2) *Halcyon chloris humii*, and (3) *H. smyrnensis fusca*.

atthis feeds typically and largely from and over water, *Halcyon chloris* from mangrove mud banks and muddy beaches, and *H. smyrnensis* from dry ground and open country away from water. In this respect *H. chloris* occupies an intermediate position between

the other two species. This also applies to the areas in which it is seen most frequently. It is usually encountered on the coast, near to or in company with *A. atthis*, but it may stray far enough from water to be found in the same area as *H. smyrnensis*.

The question arises as to whether there is any appreciable structural difference in the bills of these three kingfishers. To afford a direct comparison drawings, based on photographs, were prepared from a representative example of each species. In doing so the scale of magnification was varied, to keep the exposed culmen a constant length. The resulting diagrams emphasize the generic distinctions. *Alcedo atthis* has a fine, slender, pointed bill, with proportions roughly similar to those of the majority of the terns, birds which frequently feed in much the same manner.

The other two species, *Halcyon chloris* and *H. smyrnensis*, have much heavier, thicker bills. The gross difference between the two, however, is largely one of total size. In the flesh the length of the exposed culmens are approximately in the ratio of 1 to 1·36. When the culmen is reduced to unity the breadths, at the level of the proximal end of the exposed culmen, are in the ratio of 1 to ·8, and the depths 1 to ·94. *H. chloris*, therefore, has a bill that is appreciably shorter than that of *H. smyrnensis* in relation to the total length of the bird, and relatively broader. The lateral profile, however, is roughly similar, and in both the bill is much stouter than in *Alcedo atthis*.

Briefly it may be said that *Alcedo atthis* has a bill well adapted to stab fishing in water, and less likely to be fully effective outside this medium. The other two birds have stouter, heavier stabbing bills, such as may be seen in some of the storks, and with probably no greater difference between them than is shown by their slightly divergent food preferences. These differences, such as they are, would seem to be attributable to habit and habitat rather than bill structure.

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SOME OBSERVATIONS ON THE HABITS OF *HIPPOCAMPUS GUTTULATUS* CUVIER, REARED IN THE MARINE BIOLOGICAL STATION, WEST HILL.*

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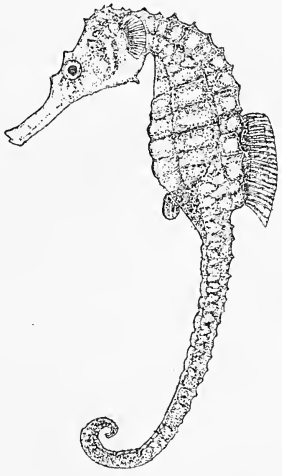
(*With a text-figure*)

'The peculiar little fishes known as sea horses have caught the popular fancy and attracted wide interest since ancient times, because of their bizarre appearance. No less than the popular attraction is the scientific interest in these fishes, because of their peculiar structure, their distinctive mode of life, and their unusual mode of reproduction' (3). The rearing of *Hippocampus guttulatus* in the laboratory of the Marine Biological Station, West Hill, provided facilities for some interesting observations.

On 10th January 1948, some fisher children brought a young *Hippocampus guttulatus* to the Marine Biological Station in a small vessel containing sea water. On enquiry they informed us that the sea horse was caught in the sea opposite Calicut in a cast net along with other fishes at a depth of about five fathoms. The fishermen had kept it alive in the sea water which had collected at the bottom of the boat.

In the laboratory, the sea horse was reared in a bell jar aquarium and the sea water in which it was kept was changed daily. The sea horse survived for sixty-nine days in captivity. It lived a solitary life in the aquarium for thirty-nine days after which a young *Therapon jarbua* (Squeaking Perch) was introduced as its companion. This perch was collected alive along with plankton in the early hours of 18 February 1948.



Hippocampus guttulatus Cuvier (natural size)

* Published with the kind permission of the Director of Industries and Commerce, Madras.

As soon as the little squeaking perch was let into the aquarium, the sea horse began to chase it, may be for preying on it. But, the small perch proved to be too quick for the slow-swimming sea horse. After chasing the perch round the aquarium a few times in vain, the sea horse gave up this pursuit. Now the perch moved to the centre of the aquarium and remained motionless, while the sea horse approached the small fish and began to stare at it. After a minute or two the sea horse produced a few clicking sounds like those produced by the Click beetles (Elateridae), which appeared to emanate from its pharyngeal region. When the sound is produced the anterior region of the operculum shows vibrating movements. It is a non-continuous, short, snapping sound produced at intervals of a few seconds. After producing half a dozen such clicking sounds, the sea horse swam away. From that time onwards not only was there no lack of understanding between the sea horse and the squeaking perch, but a new bond of friendship also was effected between them. When the perch got scared, at anyone poking a finger or a glass rod into the aquarium, it took shelter behind the curved tail of the sea horse. The sea horse also concealed the perch from the observer's view and thus seemed to protect it.

Hippocampus brevirostris, another species of sea horse is reported to produce sounds which are 'more intense and frequent in the breeding season' (1). Evidently these sounds are sexual in character. The same sounds produced when some other species of fish is present close by, might be an expression of friendship.

Norman (7) states that sea horses have a diet similar to that of the Pipe Fishes which belong to the same family. The diet consists mainly of small crustaceans. In the Marine Biological Station, West Hill, the sea horse was fed on the planktonic organisms got both in the surface and in the vertical hauls. The organisms that were consumed by this sea horse in captivity were *Leucifer hanseni*, young prawns, Isopods belonging to the family Aegidæ, and carangid fish larvæ. It was not noticed to feed on the copepods or other minute crustaceans even though they were present in abundance. When there were no large crustaceans, the sea horse starved. It preferred live organisms but when live ones were not available, it readily fed upon dead ones. Its feeding was observed to be peculiar. When it sighted prey it approached and stared at it for a time. While watching, it invariably had the end of its snout at a level lower than that of the prey. Then suddenly it made an upward jerk of the snout and the prey was sucked in, in the course of this movement. When the prey moved fast the sea horse chased it till the prey got tired and when it stopped for a short spell of rest, the sea horse swallowed it with an upward jerk of its snout.

This sea horse was a voracious feeder. Once in addition to two *Penaeus* young ones each measuring 15 mm. and two carangid fish larvæ measuring 6 mm. each, the sea horse consumed 55 *Leucifer hanseni*. All but the young prawns were dead. The cephalothorax of the young prawns were not consumed. In the case of large prey that could not be sucked into the mouth entire like young prawns, the sea horse held the prey in its mouth and by a few quick snapping movements of the jaw cut it into bits which

were swallowed subsequently. When the sea horse was holding such big prey, its companion the perch would at times snatch away the prey from its mouth. But before the perch had time to consume it, the sea horse snatched it back and swallowed it quickly.

The sea horse is considered a poor swimmer and is said to be 'carried about by currents' (8). There is no caudal fin; the tail is prehensile and used to coil round sea weeds. But even when there is no sea weed or other structure around which it can coil round, the tail is always in a coiled position, or the tip at least is curved. Locomotion is effected mainly by the small single dorsal fin which moves rhythmically in a wave like motion. The pectoral fins move forwards and backwards. These fins are much smaller than the dorsal fin.

The sea horse moves forward in an upright position and the movement is slow and graceful. But when chasing prey, it bends forwards and assumes a slanting position. Even though the sea horse sometimes dives head downward it usually goes to the bottom gradually with the head up.

Hippocampus guttulatus reared in the Marine Biological Station, West Hill was a female and a description of its external characters is given below. The description and the measurements taken are according to the method described by Ginsburg (3).

Dorsal fin rays	...	20
Anal fin rays	...	4
Pectoral fin rays	...	17
Trunk segments	...	11
Caudal segments	...	40
Total length	...	88 mm.
Length of head	...	20 mm.
Length of snout	...	8 mm.
Length of trunk	...	28 mm.
Length of tail	...	60 mm.
Orbit	...	4.5 mm.
Post orbital	...	9 mm.
Depth	...	13 mm.

Day (2) in his description of *Hippocampus guttulatus* gives the number of dorsal fin rays as 16 to 17 and the number of caudal segments as 33. But Ginsburg's description (3) of *Hippocampus guttulatus* agrees with the description given by us.

The brood pouch was absent, the specimen being a female. The dorsal fin is situated over the last two trunk segments and over the first two caudal segments. There is a coronet bear five short spines. There are two supraing orbital spines present and these are directed slightly backwards. The tubercles over the trunk and tail are short and blunt. Filaments are absent. The sea horse was dark brown in colour while alive. When it starved for a couple of days the stomach region became pale white in colour.

About the distribution of sea horses in general, Gunther (4) states as follows: 'They are pelagic fishes which attach themselves to sea weed or other floating substances and are carried by currents to great distances. Consequently, some species are spread over differ-

ent parts of the globe, like *Antennarius* a genus the geographical distribution of which nearly coincides with that of *Hippocampus*'. *Hippocampus guttulatus* also seems to have a very wide distribution. Day (2) describes it as occurring in the ' Red Sea, Indian Ocean to Japan, also tropical parts of the Atlantic '.

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TRICHOGRAMMATOIDEA NANA ZEHNT. (HYM. CHALCIDOIDEA)—AN EGG PARASITE OF THE SUGARCANE BORER *ARGYRIA STICTICRASPIS* HAMPSON : A NEW RECORD FROM SOUTH INDIA

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INTRODUCTION

Trichogrammatoidea nana Zehnt., is a minute egg parasite originally recorded from Java. It appears to be fairly common and widely distributed on several hosts in Java. Recently, Mr. S. Ramachandra Iyer, the Assistant Entomologist in the Imperial Council of Agricultural Research scheme for the investigation of borers of sugarcane in Madras, found this parasite for the first time in India from the eggs of *Argyria sticticraspis*. The writers wish to thank him for allowing them to study this parasite. In view of its importance as a parasite of economic importance with potentialities in the future in biological control work it is proposed to give a connected account of its range of distribution, hosts, possibilities of breeding and a systematic account since much of the information available is scattered in literature.

RANGE OF DISTRIBUTION AND HOSTS

Deventer (1906) while dealing with pests of sugarcane and their parasites records this on the sugarcane borer *Diatraea striatalis* Sn., and the sugarcane leaf roller *Grapholitha schistaceana* Sn. Taylor *et al* (1930) give the hosts as follows :—in Java: *Diatraea striatalis* Sn., *Chilo infuscatellus* Sn., *Scirpophaga intacta* Sn., *Schoenobius bipunctifer* and *Artona trisignata*. Ferriere (1933) mentions from specimens received by the Imperial Institute of Entomology on *Tirathaba* sp., Tineids on coconut and on eggs of *Nacoleia octasama* Meyr :, from Fiji : and on eggs *Brontispa froggatti* Shp., from Solomon Is. Ferriere also gives a further list of hosts from Sumatra and Java as a result of information obtained from van der Goot, viz., bred from the eggs of *Diatraea striatalis* and *Grapholitha schistaceana* on sugarcane, *Deiopeia pulchella* on *Crotalaria*, *Rhodoneura myrtacea* on *Palaquium*, *Nephopteryx robusta* on *Citrus*, *Heliothis obsoleta* on *Physalis*. Garthwaite and Desai (1939) mention the hosts as *Hapalia machaeralis* Walk., and *Hyblaea puera* Cram., the two teak defoliators in Burma and bred from *Corcyra cephalonica* Staint in stored rice and *Silotroga cerealella* Oliv in stored grains, Beeson and Chatterjee (1939) state that these parasites were bred with difficulty on eggs of flour moth *Diacrisia obliqua* and *H. machaeralis* in India. Glover (1939) says that it attacks eggs of *Eublemma amabilis*, *Holcocera pulverea* and the Lycaenid *Tarucus theophrastes* F., from India. Takahashi (1939) records that eggs of moth borers of sugarcane are attacked in Formosa. Recently a further record of it was obtained from eggs of *Argyria sticticraspis* from India. From the above long list of hosts it can easily be seen that this parasite can readily attack eggs of most lepidopterous insects.

A BRIEF DESCRIPTION OF THE PARASITE

Trichogrammatoidea nana belongs to family *Trichogrammatidae* and is an exceedingly small parasite. The female measures about 0.5 mm. in length. General color dark greyish yellow ; antennae and legs pale yellow ; ocelli red ; eyes dark ; forewing in the basal half with a cloud at base, the rest being hyaline; rest dark greyish yellow. Head broader than long and broadest across eyes ; anterior margin very slightly broadly arched ; surface of head finely reticulated; antennal length shorter than head and thorax. Antennae : 1st joint (scape) long, broad in the middle and narrowing gradually both ways and

as long as club ; 2nd joint (pedicel) narrowed at base and broad towards apex and about half the length of scape ; 3rd and 4th joints (ring-joints) broad, short and compressed ; 5th and 6th joints (funicles) stout and broad ; 7th joint (club) broad up to middle from base and gradually tapering to a point and club-shaped, clothed with dense hairs and much broader than rest of the joints and as long as the scape. The forewing is somewhat broadly rounded at apex with a fringe of long hairs, the front margin slightly curved within the basal region. Basal half of the wing is cloudy which is characteristic of the species. Surface of wing in the distal half with rows of hairs. Hind wings are small, long, with front margin with a joint in the middle ; surface with a row of small hairs ; wing margins covered with long hairs except the basal third. The description of the species almost tallies with the description by Deventer. A few individuals of the species, however, showed slight variation in color and size.

How to Distinguish *Trichogrammatoidea* from Allied Genera.

The genus *Trichogrammatoidea* was erected by Girault (1911) with *Chaetostricha nana* Zehnt., as the type. According to Ferriere (1933), the species of this 'can be readily distinguished from the true species of *Trichogramma* by the jointed antennal funicle in that of the male, the dark cloud at the base of the wing in the female and the longer marginal ciliation of the wing. But in the case of those at Coimbatore even the males show the cloud at the base of the wing. The three allied genera are *Trichogramma* Westw., *Lathromeris* Forst and *Chaetostricha* Walk. *Trichogramma* can be distinguished from the others in having eight antennal joints while the rest have only seven antennal joints. Of the other three genera *Chaetostricha* and *Trichogrammatoidea* have the marginal fringes long while *Lathromeris* has short ones; *Trichogrammatoidea* can be distinguished from *Chaetostricha* in having the cloud at the base of forewing (vide plate).

The genus *Trichogrammatoidea* is represented by three species, viz., *T. nana* from Java, Burma, India, Formosa and Fiji ; *T. flava* Gir , from Australia ; and *T. lutea* Gir., from Africa.

Life History of the Parasite

The parasite attacks eggs of *Earias fabia* and *Corcyra cephalonica* easily. The average duration of life cycle of the parasite in both cases is six days. In both the cases, the parasitised eggs get darkened in about three days. Out of 62 eggs of *Corcyra* parasitised, in 93·5% of the cases there was only one parasite per egg while in 6·5% of the cases there were 2 per egg. When single females were allowed to oviposit separately, a maximum number of 52 eggs was obtained in a day in one instance. The habits of *Trichogrammatoidea* are almost similar to those of *Trichogramma*, both with regard to life history details and also in the number of hosts they have in nature and the ease with which they can be bred in captivity on several hosts.

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NATURAL HISTORY OF THE GIZZARD-SHAD *ANODONTOSTOMA CHACUNDA* (HAM. BUCH.) AND ITS FISHERY ON THE WEST COAST OF MADRAS PROVINCE. *

BY

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The Gizzard-shad *Anodontostoma chacunda* provides a minor fishery on the west coast of Madras. In fact, only seldom does this species afford a fishery by itself, mostly shoaling, as it does along with other fishes like *Sardinella longiceps* Cuv. & Val., *Clupea fimbriata* Cuv. & Val., *Cynoglossus semifasciatus* Day and *Caranx crumenophthalmus* Bloch. This is termed 'Kondadi mathi' in Malayalam meaning a sardine which wags its tail. Though during the spawning season the fish is tasty, it is not preferred by many on account of the innumerable bones. The Gizzard-shad has a very elegant form and is golden in colour, shot with purple, with lines formed of spots along the rows of scales on the upper third of the body and also with a black spot on the shoulder, as described by Day (1).

SIZE RANGE

According to Day (1) *Anodontostoma chacunda* attains 20 cm. in total length, but the largest specimen examined during this investigation was only 17 cm. long. The majority of the catches ranged between 10 cm. and 15 cm. This species is noticed to attain maturity when it reaches a length of 12·5 cm. since no specimen measuring less than this ever had fully developed gonads during the spawning season.

SEASON OF OCCURRENCE

Specimens of Gizzard-shad were available for examination all through the year except during the monsoon months of June, July and August when the fishery on the whole is poor. So it may be inferred that *Anodontostoma chacunda* occurs throughout the year.

SPAWNING SEASON

Gizzard-shad with ripe gonads were available from November to March. Spent females with tape-like ovaries were available in March and April. Batches of developing eggs were obtained from the plankton in January by Devanesen and Chidambaram (2). As this fish was not available in the catches of the inshore waters these authors concluded that they were spawning offshore and this conclusion was subsequently confirmed by obtaining ripe specimens with transparent ovaries full of ova from offshore waters.

The spawning season extends from November to February. Eggs of *Anodontostoma chacunda* were again obtained from the West Hill plankton in January 1943. The ovaries, when in roe, are bright yellow, shot with red blood vessels, forming a net work on them. The gonads were noticed to be better developed on the left side, a feature not uncommon especially among other sardines of the West Coast. Devanesen and John (3) have cited a similar case in *Kowala thoracata* (Cuv. & Val.).

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* Published with kind permission of the Director of Industries and Commerce, Madras.

Food

The following items figure in the stomach contents of members of this species :—

Phytoplankton	Zooplankton
Fragillaria spp.	Copepods.
Coscinodiscus spp.	*Evadne* spp.
Biddulphia spp.	*Paracalanus* spp.
Pleurosigma spp.	*Acartia* spp.
Nitzschia spp.	*Oithona* sp.
Navicula spp.	*Euterpina* spp.
Bacillaria spp.	Bivalves, Gastropods } larval stages.
	Fish eggs.

Other items :

Fish scales.
Sand grains.

The above list clearly shows that *Anodontostoma chacunda* is purely a plankton feeder. As in the case of plankton feeders like mullets, the Gizzard-shad, as its name indicates, has a stomach resembling the gizzard of a fowl. Norman (5) states that the Hickory-shad of America which subsists on decomposing organic matter mixed with mud, also has a gizzard similar to that of this species. In the majority of cases both phytoplankton and zooplankton were present almost in equal proportions, though in a few cases, phytoplankton alone was present. Most probably this was due to the predominance of phytoplankton in the locality where the fish fed. The very rare occurrence of fish scales and sand grains cannot be taken as a proof of its bottom feeding habit as these might have got in accidentally while in suspension in the sea.

Methods of Capture

The Gizzard-shads are caught in drift nets, 'Ayila chala vala' and 'Mathi chala vala' the seine net 'Paithu vala' and the cast net 'Veechu vala'.

Place of Capture

The Gizzard-shads were caught from offshore regions thirteen miles from the shore, at a depth of fourteen fathoms as well as from very near the shore at a depth of one fathom.

I am thankful to Dr. H. Sreenivasa Rao, D.Sc., F.A.Sc., F.N.I. and Mr. P. I. Chacko, B.Sc. (Hons.), F.Z.S., for going through the manuscript and for affording valuable suggestions. I am also thankful to the various research workers who gathered the data embodied in this note at the West Hill Biological Station.

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AN ABNORMAL FORM OF LAC CELL AND ITS EARLIEST ILLUSTRATION

BY

S. Mahdihassan

(*With a plate*)

A typical lac insect has two life cycles; one matures during the monsoon season, the other during the non-monsoon period of the year. Up north, the monsoon life cycle may be as short as four months or even less, while the non-monsoon generation may cover eight months or more. In South India the species, *Lakshadia communis* covers one life cycle in five months, from June to October, the other in seven months, from November to May. Insects developing during the rains give rise to young ones in November which mature as winged males. The entire generation consists of males. The lac insects excrete honey dew which attracts flies. These visit lac encrustations at the time larvae are swarming and incidentally transport the larva far and wide, usually singly. Such isolated insects change their sex and produce abnormal forms of cells. The normal female cell is round, like a pill, that of the male on sex reversal becomes hexagonal and on account of its resemblance has been called a crown shaped cell. The generation that swarms from it, in June, consists of 13 females to 1 male, which is wingless. Thus only the crown shaped cells really give rise to any female larvae and these alone can form encrustations. It is clear that lac can be collected only at the end of the monsoon season and then as chunks being produced by the progeny of one mother insect only.

A species that shows the greatest sex ratio variation and the largest preponderence of males is *Lakshadia communis*. Naturally this insect is also the one which shows the crown shaped cells more than other species. This explains how Clusius (1), who offers three illustrations of stick lac, unwittingly illustrates in one of them a crown shaped cell, as seen in silhouette. Clusius translated a book by Garcia, who published his original treatise, at Goa, in 1563. Garcia was shown some pieces of stick lac and he probably had three illustrations made from it, but, as the press in Goa at the time could not print any figures, the original drawings were handed over to Clusius who had wood engravings made from them and the pictures reproduced in the Latin edition of Garcia's book. Even as early as 1563, Garcia reports, 'because it bears little lac they do not value it, the soil not being fit suited to reproduce it'. One can read such remarks in most official reports on lac to day! One of the three pictures by Garcia-Clusius, showing a crown-shaped cell, is reproduced as Fig. 1 here. The twig is shown natural size and belongs to *Zizyphus jujuba*, but the absence of thorns may be noticed. Fig. 3 was derived from the same species of tree but it is also devoid of thorns. The crown-shaped cell, in Fig.1, has been marked, K by me and it is further connected with a separate sketch to show the same object clearly.

The crown-shaped cell (2) usually occupies the extreme basal end of the encrustation. This is seen in Fig. 1 and is confirmed by Figs. 2 and 3 where the object is also indicated with K. This cell occurs in most cases on that part of the twig which faces the earth. That in Fig. 1, K, was the position nearest to the earth on the twig can be indirectly shown.

Flies usually settle on the twig where it is darkest, being usually a spot which faces the earth, as below a horizontal twig. On a twig which is inclined, K, would be the position facing the earth and not opposite to it. On such a twig larvae would settle mostly on the lower surface while its upper, which may be called its back, would be thinly populated or not at all. Depending upon the inclination of the twig a quantitative relationship can be

established between this factor and the intensity of infection by lac. We get all degrees of infection. Fig. 1 shows towards the right of the reader a narrow empty space where lac larvae had not settled and the space, though linear, was actually the space left unoccupied by the insects. This narrow region distinctly shows to be the one most away from the earth, hence its opposite side should be the one facing the earth, which, in Fig. 1, is the side where the crown shaped cell, *K*, is situated.

Fig. 2 shows a fresh lac encrustation on *Z.jujuba*, collected at Bangalore. A thorn at the basal end is evident. The crown-shaped cell, K, again occupies the position typical for it. The main part of the progeny derived from it has formed the encrustation which appears dusted with a white powder. Living lac insects secrete a soft wax which is dusted all over the surface of fresh stick lac. A small part of the generation died prematurely and is seen darker than the rest due to the absence of the white powdery wax; this portion of the encrustation is marked *D*. It would be apparent that the main colony of insects had settled in front of the crown shaped mother cell, the larvae having moved towards the apex of the twig which is normally the case.

The same tree which supplied stick lac, seen in Fig. 2, also gave the piece shown in Fig. 3. The crown shaped cell, seen more in profile and again at the base of the encrustation, is indicated as K. Some insects died prematurely and are marked D which appear darker from want of the white powdery wax. If Fig. 3 were to be copied and printed from a wood engraving the crown-shaped cell would not be more conspicuous than the same object, *K*, in Fig. 1. In order to appreciate my interpretation of *K*, in Fig. 1 such a visualisation would be desirable. It may be repeated that Fig. 1, *K*, shows the crown-shaped cell in silhouette. It has been already mentioned that Fig. 3 does not show any thorn although it is longer than the piece in Fig. 1, whose identity it is proposed to establish, as belonging to *Z.jujuba*.

Fig. 4 shows a twig of *Ficus mysorensis* collected at Bangalore. It was growing horizontal with the encrustation facing the earth. The picture shows it, lying on its back as it were, the scale in mm. gives the enlargement. The encrustation appears to be formed in four lumps. The largest is the basal one, with the crown shaped cell raised by it and yet attached to its surface. The basal lump is conspicuously large, while the other three are more or less similar to one another. It would be apparent that the twig is a very short one. When the larvae swarmed from the crown-shaped mother cell normally they should have moved towards the apex of the twig but the distance from the mother cell to the apex would indicate that it would have been wise for the insects not to have done so. The larvae settle once for all on a twig and in this they are guided by their instinct of acquiring food. It would appear that the food of the lac insect was not present in the part of the twig from the crown shaped cell to the apex. But since movement towards the base of the twig is also unnatural for the larvae the greatest competition has occurred in their trying to settle as near to the mother cell as possible, hence this basal part of the encrustation has become the largest.

The presence of crown-shaped cells has not been recorded in the literature by any other worker on lac. Fig. 4 has been specially offered to show what a conspicuous object it can sometimes be. There appears to be one more record of it than that of Clusius which is by Chamberlin (3) who found it in the species *Lakshadia chinensis* but wrongly named it as a new species *L. rangoonensis*. Strange enough this author does not admit *L. chinensis* to be specifically different from other lac insects.

SUMMARY

In 1567 Clusius printed the first illustrations of stick lac. The pictures were first made by Garcia at Goa in 1563 and passed on to Clusius who translated his book into Latin. One of these three illustrations is an encrustation of *Lakshadia communis* formed by a progeny that issued from a single crown-shaped mother cell. This object is seen at the base of the encrustation in profile and as silhouette. Similar encrustations are shown to support the interpretation of the object illustrated by Garcia-Clusius, as a Crown-shaped cell.

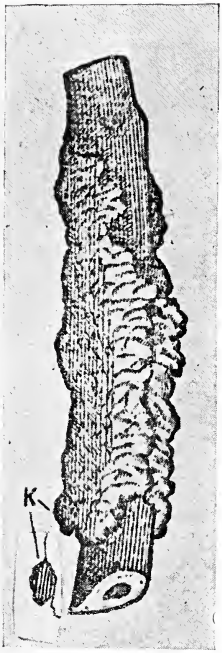

Fig. 1

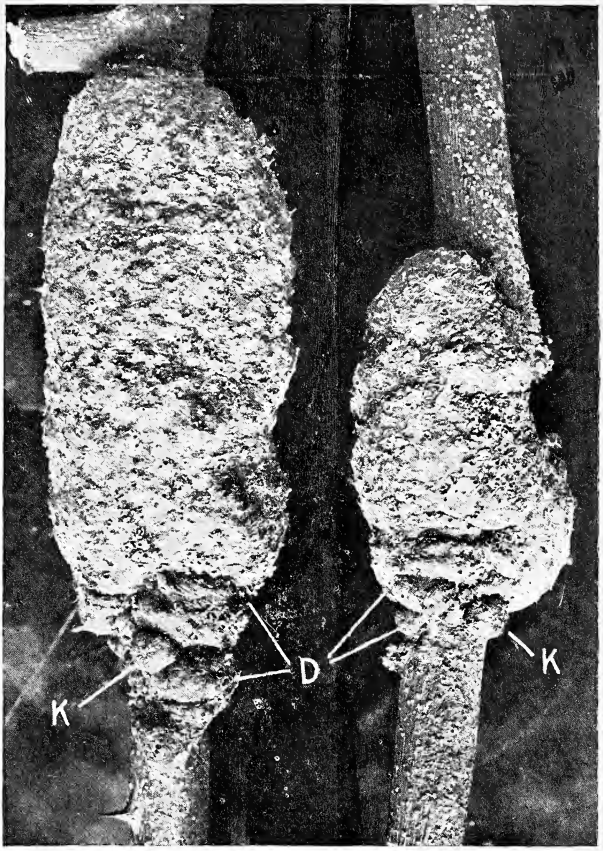

Fig. 2

Fig. 3

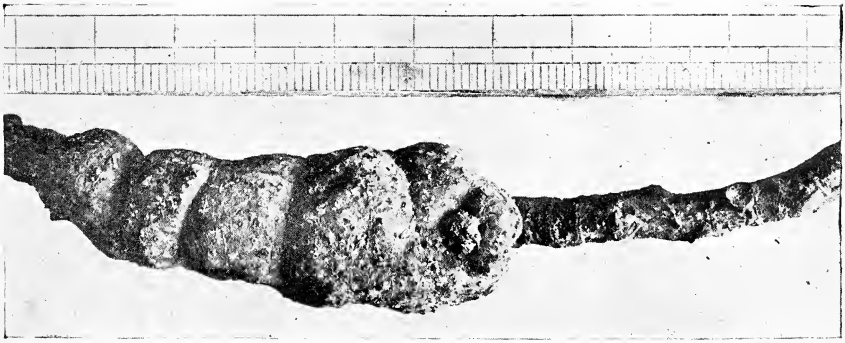

Fig.

For explanation of figures see end of the article.

Explanation of Figures.

Fig. 1.—Stick lac illustrated by Garcia-Clusius in 1567. The crown-shaped mother cell K is also shown separately.

Fig. 2.—Encrustation of *L. communis* on *Z. jujuba*. Crown-shaped cell is K, the dead insects are marked D. Magnification 11:10.

Fig. 3.—Encrustation of *L. communis on Z. jujuba*. The twig shows no thorn. The crown-shaped cell K, and dead lac insects D are indicated. Magnification 11:10.

Fig. 4.—Fresh stick lac of *L. communis* on *Ficus mysorensis*. The crown-shaped cell, hexagonal in outline, is self evident. The enlargement is shown by a mm. scale.

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2. S. Mahdihassa: The probable occurrence of sex-reversal among lac insects. *Zeit. f. ang. Entomol.* 1930; 16: 527.
3. J. C. Chamberlin: Laccifer rangoonensis *Btn. Ent. Recs.* 1925; 16:35.

REVIEWS

1. 'PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF BENGAL' Vol. I, No. 1, March 1948.

The appearance of a new zoological periodical in India is an event which cannot be passed over without comment. Through the enthusiasm of a few zoologists in Calcutta, the Zoological Society of Bengal was founded some years ago and that Society has now brought forth its *Proceedings* in the form of a biannual journal. The first number of the *Proceedings* covers 78 pages and contains several text-figures and four plates. There are, in all, eight research papers dealing with a wide variety of subjects ranging from the cytology of grasshoppers, the development of fish scales and the descriptions of new parasitic protozoa, to the development of the vertebral column in the alligator.

The editing is good, the figures and plates well drawn and well captioned, and it is a pleasure to congratulate the Society on the production of this excellent journal. A few improvements that strike us may be mentioned—not so much as criticism as by way of helpful suggestions. For instance, the titles of various papers can be made more comprehensive and attractive by the addition of common English names of animals: thus instead of 'Meiosis in diploid and tetraploid spermatocytes of *Attractomorpha* sp.', the title could profitably be 'Meiosis . . . in the Short-horned Grasshoppers, *Attractomorpha* sp.' It is also rather unfortunate that the grasshoppers were not identified specifically, for that would have enhanced the value of the paper.

The headquarters of the Society are situated in the Zoological Laboratory of the Calcutta University at 35, Ballygunge Circular Road, Calcutta. The President for the current year is Professor H. K. Mookerjee, the Secretary Dr. S. P. Ray Chaudhuri, and the Editor Dr. J. L. Bhaduri.

We wish the Society and the *Proceedings* a happy and prosperous career and hope that they will be able to maintain the standard that they have set for themselves in the first number.

2. BIBLIOGRAPHY OF HOMOPTERA AUCHENORHYNCHA. By Z. P. Metcalf, Dept. of Zoology, State College Station, Raleigh, North Carolina. U.S.A., 2 vols. 1947, published by the author, price $7.50.

It is well known that the Germans have given us model examples of monographic studies. The Americans deserve the credit for compiling ideal bibliographies. On scale insects Mrs. Fernald's bibliography was not only the first but is still the only one existing. We have now Prof. Metcalf's Bibliography of Homoptera in 2 vols. The work is published by the author which accounts for the modest price of the book. The publication under review is really an encyclopaedic bibliography which leaves nothing to be desired. The printing and binding are excellent and there are 1100 pages of clearly printed matter.

Vol. I comprises of nearly 900 pages of papers by authors whose names appear in alphabetical order. An average page consists of more than 11 entries so that there are about 10,000 papers indexed.

Vol. II contains in all 186 pages of which 85 are occupied by the list of different journals from which the bibliography has been compiled. Taking 16 names on an average page, over 1350 journals have been mentioned To extract 10,000 titles from 1350 journals is a gigantic task and a country like India one would be fortunate if one could find even 300 of these in libraries throughout the length and breadth of the country. It is in such gigantic undertakings that the American workers seem to excel.

Pp. 105-186 contain a summary of the analysis of the 10,000 papers listed. This index is as perfect as it could be desired. Papers are divided according to the geographical distribution of the insects, also according to their family, to their host plants and according to the physiological, ecological and anatomical studies carried out on each family of homopterous insects.

If the compilation of Vol. I shows indefatigable labour, Vol. II shows a thorough mastery of the contents of the papers. Prof. Metcalf's bibliography is sure to be of interest to every entomologist working on homopterous insects and will long remain the only encyclopaedic source of information upon them.

S. Mahdihassan.

3. CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA. By A. St. J. Macdonald, with 4 coloured. 17 black and white plates and 64 text-figures: pp. ix-306. $9\frac{1}{2} \times 6\frac{1}{2}$ in. Published by the Bombay Natural History Society. 1948. Price Rs. 15.

Since the days of 'The Rod in India' by H. S. Thomas (the first edition of which was published in 1873, the second—and best—in 1881, the third in 1897) several books on freshwater angling in this country have appeared. Some of these are mentioned at pp. 255-256 of the book under review; one—'Sunlit Waters, An Introduction to the Art of Fishing with Light Tackle' 'by Capt. C. W. W. S. Conway, 1942—should be included.

Though all these fulfilled a want in some way, none of them approached the present volume by Mr. Macdonald. This is an up-to-date and fully comprehensive work on all aspects of angling in the rivers and lakes of India and Burma. Through contributions by sea angling experts, and a list of references at page 175 it also effectively deals with Sea and Estuary Fishing along the coasts of India from the Persian Gulf to Calcutta; also Aden, the Andaman and the Laccadive Islands

The material of the book passed through the pages of the Society's *Journal* in a continuous series from August 1942 to August 1946, and now takes its place as one of the growing library of authoritative volumes published from time to time by the Society, having been written by its members:—The Game Birds of India, Burma and Ceylon in three sumptuous volumes; Indian Pigeons and Doves similarly produced; Some Beautiful Indian Trees; The Identification of Indian Butterflies; The Book of Indian Birds; The Book of Indian Animals; and now this book on Angling which will be the companion of the sportsman on his outings and his guide and mentor as to all matters piscatorial. There is little that even the most experienced angler will be able to add to or modify. As the immortal Thomas wrote, 'If old hands, nevertheless, find nothing new in these pages, will they kindly consider that it is mainly their own fault for knowing too much'!

As to spinning dead bait the author rightly points out (page 47) 'it is the pace that kills—the correct pace', and that, it may be said is the pace discovered through intelligent use of experience. In para. 30, page 53 it is correctly pointed out that agate rings are easily damaged. The experience of your reviewer is that so much is this so that such rings should be avoided. Often will the rod-repairing expert show to his customer through the magnifying glass (p.28) that his precious agate rings are cracked and causing unsuspected line damage. This is only one of the many ways in which this book will quickly repay its purchase price. Rings of stainless steel would be safe and everlasting; but that would not be good for the trade! Protected porcelain rings are as good as agate.

That scaled spoons attract fish is rightly remarked at page 46 para 10. This has been found in a number of rivers, among others the streams of the Western Ghats, where also less glittering spoons of frosted silver finish do better than ordinary bright spoons. (See Angling Localities, page 296).

One could wander through the book in this way for a long time. Enough has been said to show what a wealth of information and detail is here at the disposal of the angler.

The angler will feel the need of a General Index[1] use of which would save much time and some irritation. Such an Index should be provided in any subsequent edition. The value of a book is much enhanced by a good index. The 1881 'Rod in India' is an example of this. The labour to the author is abundantly repaid by increased pleasure in use afforded to the busy angler. Cease, carping critic!

The book contains twelve chapters:—Mahseer Fishing as compared to other sport; Simple Natural History of the Mahseer—Fishing for Mahseer—The Mahseer in Burma—Mahseer Fishing in Assam and the Dooars—Other Sporting Fish and How to Catch Them—Sea and Estuary Fishing—Tank Angling—Scraps from My Note Book—Advice to Anglers; and a 47 page Localities Index which will be a valuable guide to the angler wherever he may happen to be.

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[1] For the inadvertent omission of the author's carefully prepared index the publishers tender apology both to the author and to users of his book. EDS.

The book is well bound, printed and produced. There are few printers errors. At foot of page 35 the name 'Mr. Verhgen' should read, 'Mr. J. de Wet Van Ingen.' A photograph of this, now the record Mahseer, and of its captor is at page 406 of Vol. 46 of the Society's *Journal*. Photographs with account of capture of the former record fish of 119 lbs. and the next largest of 110 lbs. are at pages 662-663 of Vol. 43. Another account of the taking of the 119 lb. fish is at page 254 of this book. The name 'Corbet' at p. 36 should be 'Corbett'.

The coloured plates following page 6 well illustrate the several forms of Mahseer met with in India, Assam and Burma. 31 of the 'Other Sporting Fish' are well depicted by pen-and-ink sketches. The angler who possesses or obtains from the Society the re-print (Nov: 1932 66 page pamphlet on 'Game Fishes of Bombay'—item 6 page 256) will have 14 coloured plates of some of these, as also further local and other useful information regarding the Bombay District and the Deccan. Some of the sea fish are illustrated by photographs.

The many text-figures—of which there are 85 and not 64 only as mentioned on the title-page, greatly assist the informative nature of the book.

Both the angler of less experience and the novice will be quickly repaid the quite moderate purchase price of the book through saving in a number of ways of otherwise expensively acquired experience: and it will be greatly valued by all who possess it.

R.W.B.

The following books have been added to the Society's Library since October 1948:—

1. CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA. By A. St. Macdonald (The Bombay Natural History Society, Bombay, 1948).
2. FISHING. By Clifford George (Oxford University Press, 1948).
3. THE GARDEN IN THE PLAINS 3rd Edn. By Agnes W. Harler (Oxford University Press, Bombay 1948).
4. ALPINE FLOWERS (Iris Book). (Oxford University Press, 1945).
5. WONDERS OF THE SEA—SHELLS (Iris Book). (Oxford University Press, 1945).
6. WONDERS OF THE SEA—LIFE OF THE OCEAN—FISHES ETC. (Iris Book). (Oxford University Press, 1945).
7. THE BEAUTY OF BUTTERFLIES (Iris Book). (Oxford University Press, 1945).
8. MAMMALIAN GENETICS. By William E. Castle (Oxford University Press, 1940).
9. MANUAL FOR A LABORATORY COURSE IN GENETICS—TO ACCOMPANY THE TEXT BOOK MAMMALIAN GENETICS. By William E. Castle (Oxford University Press, 1940).
10. THE GENETICS OF DOMESTIC RABBITS. By William E. Castle (Oxford University Press, 1930).

OBITUARY

T. R. D. BELL

With a plate

The late Thomas Reid Bell was one of the oldest members of the Society and spent the greater part of his life in the Bombay Presidency. He was born at Bandon, Cork, on 2nd May, 1863, and was the youngest of a family of twelve. After leaving Ireland his mother went to live in Dresden and most of his boyhood was spent there. When he was about seventeen or eighteen he came to London and attended classes at Messrs. Wren and Gurney, the well-known crammers, where one of his brothers was a tutor. He tried for the Indian Civil Service but failed and, at the instigation of his brother, sat for the entrance examinations to both Woolwich and Sandhurst which he passed. He decided, however, not to enter upon an Army career and later passed the examination for the Indian Woods and Forestry Service. After undergoing the usual instructional training in Nancy, in France, he went out to India in 1884 and was appointed District Forest Officer, Dharwar, on 24th November. At that time Colonel Peyton, one of the Army officers appointed to the Forestry Service at its inauguration, was in charge of the Southern Division. He was a great shikari and a noted shot, and Bell started his training under him. I remember Bell telling me that the first time he went after a tiger with Peyton the tiger came out of the beat in front of him and he killed it with a shot in the head, the bullet passing through an eye. Some time later he took part in another beat and again the tiger came out to Bell, who killed it with a similar shot. Colonel Peyton, after examining the dead tiger, turned to Bell and said: 'Young man, do you always shoot your tigers through the eye?'

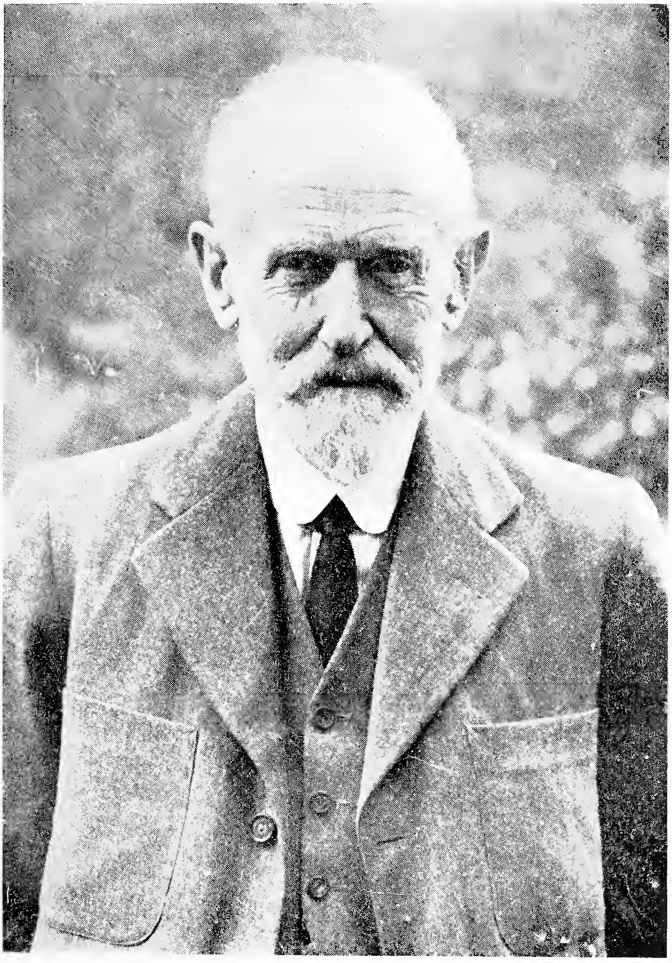
Although Bell had shot all kinds of large and small game he was more interested in entomology and other branches of natural history. In the *Journal*, Volume xv, pp. 344, he graphically described an eerie experience with a man-eating panther. The animal had made a practice of taking natives from machans while guarding the crops. Bell sat up in a tree for the panther and presently he saw it looking at him from some long grass in front, then it disappeared. After a time he had an uncomfortable feeling that something was watching him from behind. Turning cautiously round he saw the head of the panther looking at him round the stem of an adjacent tree. Slowly raising his rifle he fired, but when the smoke cleared away the head was still there, the animal had not moved. Fortunately a second shot sent it crashing to the ground.

In the early nineties natural history flourished in Kanara. Bell was the Forest Officer, James Davidson, his life-long friend, the Collector and E. H. Aitken in charge of Salt and Excise. The last named, better known as Eha, was the son of a Scottish missionary at Satara, and as a small boy used to while away the tedium of a

strict Sabbath by watching his caterpillars. After entering Government service Aitken began to make a special study of the life histories of butterflies and along with Davidson wrote several papers on the subject for the *Journal*. In his study of lepidoptera Bell owed much to these two, and in 1896 all three combined in writing a paper on the butterflies of North Kanara, his first contribution to the *Journal*. In addition to his great interest in entomology Davidson was a keen ornithologist and had contributed papers to *Stray Feathers* and the *Journal*. But his principal interest in birds was their eggs, and for long he had wished to make a trip to Kashmir to collect birds' eggs. After he retired in 1896 he was able to put this into execution and invited Bell to accompany him. In his account of the expedition, which he wrote for the *Ibis*, Davidson remarks that his companion had for many years been a great collector of lepidoptera and coleoptera but had not hitherto taken special interest in birds or their eggs. The two spent about six weeks in Kashmir going as far as Sonamarg, but although they collected many eggs and butterflies, the season was rather a disappointing one. Nevertheless the trip had one important result—it aroused Bell's interest in both birds and their eggs, especially the latter. After Davidson went home in 1896 Bell corresponded regularly with him and I, fortunately, have several of these letters, which are full of his bird-nesting activities and finds amongst the lepidoptera.

Towards the end of the nineties he was transferred to Khandesh where he took every opportunity to increase his insect collection. About this time he sent his entire collection of beetles to H. E. Andrews but this did not mean he gave up collecting these insects—far from it; he began at once to form another collection. But in Khandesh at least he seems to have paid more attention to moths and hymenoptera. During the nesting season he devoted what time he could spare to searching for the nest of the aberrant tree creeper *Salpornis spilonotus* which was not uncommon in the forests of the northern parts of the district. But all attempts to find a nest failed in spite of the fact that he enrolled the help of a fellow D.F.O., the Commissioner and even the wife of the Commissioner. Then one morning he heard one of the birds singing on a tall bare leafless tree and after much searching through his glasses he noticed a small nest in the fork of a slender branch with the bird sitting on it singing! In no time he was up the tree and secured the eggs, the first taken in the Presidency.

In 1899 Bell was back again in Kanara but not for long as the Government decided that he should have some experience of forestry conditions in Sind. Bell protested, but Government was adamant and to Sind he had to go, vowing that he would not shave until he returned to Kanara—nor did he. In Sind, however, there was much to interest him and the bird and insect life was very different from that of Kanara and Khandesh. Hymenoptera were specially interesting and he met with many species of butterflies new to him. He paid special attention to the breeding birds and found the nests of a number of species previously only known from Scrope Doig's paper on the Birds of the Eastern Narra Canal many years previously. Near Karachi he discovered that, in the hottest parts of the year, the



The late T. R. D. Bell, C.I.E., I.F.S. (Retd.)

Desert Lark *Alaemon alaudipes* was not uncommon as a breeding bird. While on tour in the northern part of Sind he secured two examples of the Penduline Tit, *Remiz coronatus*, at Ruk near Sukkur on 27th February, 1904, a species not previously recorded from India. When not on tour he lived at Clifton close to his old friend Aitken, now Collector of Customs and engaged in writing the natural history part of the Sind Gazetteer.

In October 1904 his sister Eva came out to stay with him and soon adapted herself to camp life. Bell was anxious that she should see Kanara as soon as possible and arranged to spend Christmas at Karwar. The journey from Bombay was by rail so that he could show his sister the scenery of the Poona and Goa ghats. Karwar was reached at midnight 'just as the moon was rising over the mouth of the Kalanaddi with the black outline of the Ghats beyond.' They stayed at the Gaddhelli bungalow and he wrote to Davidson that Eva 'is pleased with everything and I think would like to stay here always.' How delighted he must have been that his sister had fallen under the spell of his beloved Karwar. He now began to talk of buying a bungalow there. Early in 1906 he was transferred to Belgaum and in 1907 we find him writing to Davidson about the moths he was breeding and his hunts for the nest of the Broad-tailed Grass Warbler *Schoenicola platyura*. Later he moved to Karwar and while there got a thorn into his foot which developed into a blister corn making walking impossible. Ultimately he had to go to Bombay for an operation and after some of the surrounding tissue had been removed and examined it was pronounced to be malignant. Bell immediately went home for further advice and on arrival in London went straight to H. E. Andrews at Highgate. Much to the relief of all his friends the previous diagnosis was not confirmed and before long crutches were dispensed with and he could walk as before. This was his first leave home but though he was delighted to see his friends, towns whether they were London or Edinburgh (where he stayed with Davidson) were not to his liking and by the end of 1908 he was on his way back to India.

A series of papers on the Common Butterflies of the Plains of India by L. C. H. Young had been commenced in the *Journal* but unfortunately owing to ill-health Young had left India. Our then secretary, Mr. W. S. Millard, approached Bell to continue the series which, after some hesitation, he agreed to do. In addition to descriptions of the perfect insects Bell added descriptions of the larvae in different stages and ultimately the series, after many delays, was finished in volume xxxi pp. 951. The work was a valuable contribution to our knowledge of the life histories of Indian butterflies but the descriptions, whether of the butterfly or the caterpillar, were too detailed for the ordinary collector.

Some time after his return to India I went to stay with him at Karwar—a never-to-be-forgotten experience. I remember him taking me his favourite walk up the hill behind the bungalow and after scrambling over some rocks we reached the summit above the tree-tops. What a wonderful view there was and what a sight for the naturalist! About the tops of the trees numbers of butterflies were flying to and fro, and flitting from one tree to another were drongos

wood-shrikes and brilliant coloured minivets. A walk in the jungle with Bell was always of interest; but one had to be in good condition as he moved fast and had a way of gliding through the thick places, which made it difficult to keep up with him. Every now and again he would stop and examine the leaves on a tree or shrub and as likely as not discover some caterpillars, which would promptly be bottled. He had a wonderful ear for bird-notes and was very good at finding nests.

In either 1912 or 1913 both his sisters came out to India and he was never happier than when he had some of his family with him. He became Chief Conservator of Forests for the Bombay Presidency and then had to live in Poona and spend most of his time in an office, but whenever possible he escaped to inspect forests in the lesser known parts of the Presidency.

Bell was awarded the C.I.E. in 1911, but such honours interested him little, and it was not until two years later that the decoration was formally presented to him, and then only after a hint from high quarters. His official service came to an end in 1920 and thereafter he settled at Karwar where he was joined by his sister Eva. Not long after his retirement his brother Jim came out to visit him and the two brothers and Eva made a trip to Kashmir and Baltistan. I know little of that trip except that he got some interesting butterflies and sent a number of birdnotes to Davidson.

A few years later he started an unfortunate venture and went into partnership in a timber business in Savantwadi State. At first all went well, then things began to go wrong; his partner disappeared and after months of worry the business was finally wound up, but not before Bell had lost a good deal of money. He was no business man, was too trustful of others and to attend to the work he had to be constantly at Savantwadi away from his sister at Karwar. Added to all this he had recurrences of dysentery which he had first contracted in Sind.

In 1930 Bell sent his entire entomological collection home to the British Museum, where he thought it would be safer than at Karwar, and afterwards presented it to the National Collection. This magnificent gift was probably the largest collection personally collected by one man and consisted of 3,000 butterflies, 12,000 moths, 1,900 coleoptera, 1,720 hymenoptera and 20 orthoptera. In many cases there were long series of butterflies and moths bred by himself. For many years he had taken an interest in hawkmoths and had been in correspondence with the late Lord Rothschild and Dr. K. Jordan in England and Major F. B. Scott, a keen collector in Assam. By 1924 Bell and Scott between them had bred eighty out of the one hundred and ninety-two species known to occur in India, Burma and Ceylon, and the former's collection contained some 1,500 specimens. He now was desirous of publishing a review of the Kanara Sphingidae with descriptions of the larvae, but unfortunately his manuscript was so bulky that none of the Societies he approached would publish it. This was a very great blow to him, but fortunately it was ultimately arranged that he and Scott should combine together and write the volume on the Sphingidae in the Fauna of British India series which was published in 19.

In 1936 Bell came to England and visited many of his old friends but spent most of his time working in the Museum at his moth collection with H. W. Tams. Early in the following year he was joined by his brother and then they both went to Lucerne where his sisters were living. In the late spring he returned to Karwar with Eva and settled down to the old life. Four years later, on 17th May 1941, his sister Eva died after a short illness. This was a great blow to Bell, who was very deeply attached to his sister, and it is doubtful if he ever fully recovered from it. Without Eva life in Karwar was very lonely; his health began to fail and he was unable to use his car and now could only walk very short distances on level ground. All this must have been a very great trial to one who had led such an active life. His health did not improve and in 1946 his niece, Letty Bell, flew out from Switzerland to join him. Early in 1948 he became worse and after much suffering died on June 24th.

Besides being an entomologist and ornithologist Bell was a keen botanist and with the late L. J. Sedgwick, I.C.S., made a study of the flowering plants and grasses of Kanara. Between them they brought together a large collection which is now in St. Xavier's College, Bombay. In later life orchids occupied his attention and his sister made many beautiful paintings of them.

India has been the scene of the labours of many fine naturalists but it is doubtful if any have excelled T. R. D. Bell in all-round knowledge of game animals, birds, insects and plants. He was specially a field naturalist, but unfortunately he published little and much of his knowledge dies with him, although all his life he kept careful notes.

He will be mourned by a very large circle of friends who will look back with pleasure to the delightful days spent in his company. One can picture him now in his beloved Kanara, his tall, slim figure, with exceptionally long legs, clad in a suit of green shikar cloth of peculiar make, with white canvas rope-soled shoes on his feet striding through the jungle or jumping from one rock to another with extraordinarily youthful agility. That was T. R. D. Bell as we love to think of him.

N. B. KINNEAR

CAPTAIN G. C. SHORTRIDGE

(*By courtesy of 'The Times'—London, January* 20, 1947)

Captain G. C. Shortridge, director of the Kaffrarian Museum, King William's Town, South Africa, whose death has already been reported, was well known as a naturalist and collector of wild animals.

Guy Chester Shortridge took part in some seven expeditions on behalf of the British Museum—to Australia, New Guinea, Java, and Borneo, besides visiting Guatemala to obtain live animals for the Zoological Society of London. Oldfield Thomas, for so long in charge of the mammal collection in the British Museum (Natural History), considered Guy Shortridge the best collector who had ever worked for the museum. It was on Thomas's recommendation that Shortridge went to India to join the Bombay Natural History's Mammal

Survey in 1912 and during the two years he was there he brought together a wonderful collection of specimens from southern India and Burma. He had a way of interesting people in his work and before he had been long in the country he had district officers, police, and coffee planters all helping. From southern India he went to Burma where he was at the outbreak of the 1914–18 war.

Hurrying back to Bombay he was just in time to get himself enrolled as a dispatch rider on the staff of the Indian Expeditionary Force then embarking for France. He also saw service in Palestine, where he found time to do some collecting and in Iraq, where he was attached to the R.A.F. as an observer. After the war he went to Northern Rhodesia on behalf of the British Museum and while there was appointed to the charge of the Kaffrarian Museum at King William's Town. The museum prospered under his charge and plans for increasing the buildings were proposed a few years ago. But Shortridge was not content with the life of an ordinary museum curator. He longed to be in the open again collecting. With the help of money he raised locally, and from the British Museum and American sources, he made repeated trips to all parts of the Union and there is now in the Kaffrarian Museum the finest collection of South African mammals in existence.

At the outbreak of war in 1939 Shortridge at once volunteered for active service, but he was over age and had to be content to work in Pretoria and Nairobi preparing a useful little gazetteer of Abyssinia and Somaliland which was of much value in the Abyssinian campaign. Much to his disappointment he was not allowed to accompany the South African troops in the North African campaign. In spite of his age—he was over 60—Shortridge made further collecting trips after the war, extending his operations to Nyasaland. In 1934 he published a two-volume work on the mammals of South-West Africa which dealt with the habits and distribution of the species found in that area.

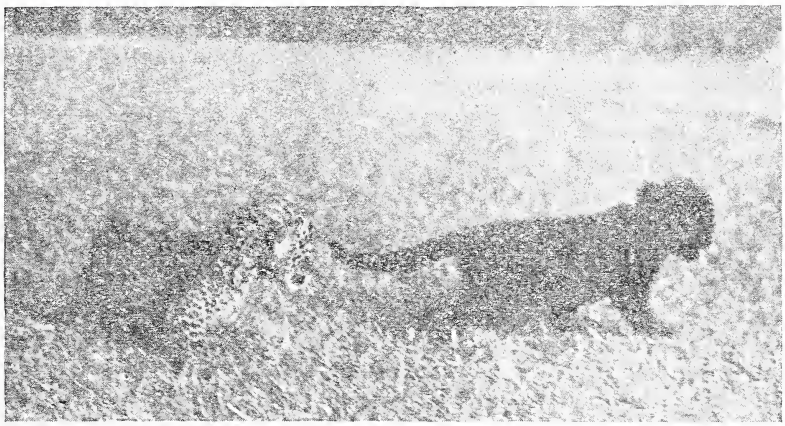
N. B. K.

MISCELLANEOUS NOTES

1.—BLACK LEOPARD CUBS

(*With a photo*)

About ten years ago a litter of two leopard cubs was found near Golaghat in central Assam, and sent to me by a friend. One of them was black and the other normal-coloured. The mother was seen, and was normal-coloured. The father was not seen, and may have been black or spotted, but there was no definite report of a black leopard in the district at that time.



I dare not enter into the complex questions of how and why melanism in leopards originally came into being, a problem which I think has never been satisfactorily explained by anyone. But I have tried to fathom the laws of genetics by which black cubs are produced.

One fact appears to have been established: that black leopard mating with black produces only black offspring. This has been proved many times; for instance in the Alipore Zoo, Calcutta, during the years up to 1926 successive litters of all-black cubs were produced by a pair of black parents. And in the Kolhapur Gardens three similar all-black litters were born to black leopards. In no instance was there a throwback to the spotted type. I presume, then, that melanism is either a dominant character of the 'pure' kind, or else a recessive, always breeding true in accordance with Mendel's theory.

Much more complicated seem the laws, if any, governing the proportion of black and spotted cubs of (1) black and spotted parents, and (2) spotted parents of which one or both have had a black ancestor. I do not know if any records of such breeding

in zoological gardens exist, or if so what the results were. It would be only in captivity or semi-captivity that accurate observations could be made, for in the jungle the absence of the male parent when the cubs were born would give rise to doubts. A further difficulty lies in the fact that in the cat family mothers often devour one or more of their own litter, and it is not unreasonable to suppose that, in a litter of three or four cubs of a spotted mother, the first to go would be a black cub.

It is well known that black leopards readily mate with the spotted type, but I cannot help feeling that if a black animal actually had the choice of a mate it would choose one of its own colour, and vice versa.

I presume that the law of genetics in the case of black and spotted leopards would also apply to black and yellow domestic dogs, such as black and yellow Labradors, Retrievers and the like. It is possible that someone may have worked out the colour variations of breeding these kinds of dogs, and compared them with existing records concerning leopards.

More information on the above subjects would prove of great interest.

Doyang Tea Estate,
Oating P.O.
Assam. E. P. GEE

[Sterndale quoting Blyth (Mammalia of India, page 176) records one black cub in a litter of 4 when both parents were of ordinary colour. He also records that a black leopard was often seen and known to consort with an ordinary female. There are many cases of black leopard being crossed with black leopard and the offspring has always been black. This coupled with Blyth's reference above leaves little doubt that melanism in leopards is controlled by a double or 'pure' recessive and it can be carried for many generations without showing any change.

Pocock (Fauna, Mammalia, Vol. 1, page 224) writes 'There is no doubt that in certain parts of British India black leopards are much commoner than in others. They have been recorded from Ceylon and appear to be not uncommon in parts of South India and Assam. They crop up in Burma and the percentage of black specimens seems to increase southwards through the Malay Peninsula until they become the dominant if not the sole type of leopard in the south of that country'. He also states that there is some evidence 'that blackness is a discontinuous variation—that is to say that a leopard is black or normal colour. Cubs of the two types have been found in the same litter.' This endorses the assumption above. Black leopards have been recorded from Southern Rhodesia and Abyssinia. (G. C. Shortridge, The Mammals of South West Africa, page 97.)

Melanism is due to superabundance of black pigment and has been described in many birds such as bullfinch, skylark and particularly in the Common Snipe, which has been regarded as a distinct species, Sabine's Snipe (Newton's Dictionary of Birds, page 99).

Huxley (Evolution, pp. 103-5) refers to hamsters in Siberia, opossums in Tasmania and the bird *Coereba* in the West Indian Islands, in which melanic forms occur with varying frequencies in different areas. As a general rule humidity appears to favour melanism and this is in keeping with the frequencies of black panthers in India and the neighbouring countries.

It is interesting to refer here to the occurrence of melanism in many species of moths and butterflies which has become markedly more frequent during the last century in the industrial districts of Great Britain; so much so that in some cases the entire population of an industrial area or large city has become melanistic. Cott (Adaptive Coloration in Animals, p. 17) believes that this may be due to the 'smoke-blackened' countryside of many manufacturing districts, where the physiological advantages inherent in melanism, would more easily outweigh the disadvantages of conspicuousness. Huxley stresses the fact that melanism is physiologically useful and confers extra hardiness and viability only when it is controlled by dominant or partially dominant genes. We have no information on the hardiness or viability of black leopards, but it is generally believed that they are more fierce than the normally coloured ones.

Ernst Mayr in his 'Systematics and the Origin of Species' holds that mutations of this kind, i.e. albinism and melanism, are of little interest in evolution except that allied families show similar traits, and their phylogenetic affinities can thus be established, e.g. albinism among the herons. In this context it is noteworthy that no authentic record of melanism in the tiger has yet been established.

The records of black leopards mating in the Calcutta Zoo have already been published in the *Journal*. We do not know whether there is any justification for Mr. Gee's feeling that if a black leopard had the choice it would mate with one of its own colour. Colours in dogs are also genetically transmitted, but we do not know which are dominant and which recessive, and it is also possible that this character may vary with the different breeds of dogs.—Eds.]

2.—A TALE OF MANY TIGERS

Mr. Randolph C. Morris sends us for publication the following extraordinary account dated 6-2-1948 received by him from Dr. Willoughby Grant of Kempstowe Nursing Home, Ootacamund. The writer of the note vouches for its accuracy and adds that the rifle he used was a .350 Rigby.

'I went up to Mukerti (Nilgiris), not far from the bungalow, and camped, with the idea of verifying a report that there was a 40" sambar there. On the Tuesday morning I went up to the top of the hill behind the bungalow and sat up amongst some rocks. The sambar stag came out but, as was expected, it was only about a 34". So I let him alone and only watched him through glasses. After a time he became suspicious of something, and looking in the direction he was looking in, I saw a tiger come out on the

opposite hill, about 300 yards off. The tiger after a time lay down watching the sambar. I watched them for about half an hour and then I wanted to get back to camp for breakfast, but was persuaded to take a long shot, as it was absolutely impossible to get any nearer. I took the shot with the 300 yd. sight up and dropped it. We then, with difficulty, got to it (took about $1\frac{3}{4}$ hours!). It was a young tigress, but we found many other tiger footprints just inside the shola where she was lying. We got her into camp and I went out the next day, Wednesday, and sat up again all day, but saw nothing at all till about 5.30 p.m. When I got up to leave, the shikari spotted a tiger sitting down in the long grass right away at the bottom of the hill. As it was getting dark, I took a long shot again with the 300 yards sight up. I hit him in the back and he tried to crawl away, when, without any warning, either 7 or 8 tigers were upon him and started to tear him to pieces. It was impossible to shoot into the bunch with any hope of success, so I watched with glasses and could make out one tigress with two full grown cubs, one tigress with two half grown cubs and two tigers; but the scrum was so great I was not sure of 7 or 8. After a time the whole lot went or rolled down a bank and out of sight. In a few minutes one came up and I shot it. As it dropped all the rest came up and fell on this one. Again the same thing happened and they all rolled out of sight. Then after about 5 minutes one came up and showed itself and I hit that, and again this was set upon. In this case, there was a hell of a fight, and no end of a din. I heard all this going on although I could not see anything of them at all.

The following morning, I went for the pick up. I retrieved one tiger intact, one half eaten (lower half) and one completely eaten except for 4 pads and one side of the head. That the tigers ate them I am quite certain of because there were only tiger footprints round the carcases, and the ground was wet. Had there been any other footprints we couldn't have helped seeing them.'

EDITORS

3.—'DEATH CRY' OF TIGER

It was only on reading Mr. Dunbar Brander's note on 'Shamming Death' (Vol. 46, p. 399) that it occurred to me to make mention (Vol. 46, p. 719) of the death cry of the tiger, and it was then, giving thought to the matter, I realized that I had not read anywhere of this cry having been recorded. Now that Mr. Dunbar Brander in his additional note on the subject (Vol. 47, p. 557) confirms there is no previous record, members interested will welcome further details.

It would seem remarkable that in the hundred and more books relating shikar experiences in this country during the past century and a half there should have been no mention of this death cry, which must have been uttered by some of the many thousands of tigers slain during that long period. Probably it has been, as with me, that it did not occur to those who heard it to say anything about it.

Perhaps many have heard, as I have, the death-yowl of a domestic cat killed by dogs so did not think it as at all extraordinary that the largest of the felidae should utter a similar cry when at point of death from a violent hurt.

1. *4th February* 1925, where the cart road crosses the first nala west of Junapani village in the Jarkahu Shooting Block of the Hoshangabad Forest Division: The tiger came to the kill at a few minutes to eight p.m. and the ·470 soft nose bullet hit him too far back on the body. I had no torch and the radium foresight did not show up as the moon was from the front. Full moon was four days later. With the moonlight from behind the radium sight is excellent, but under the circumstances it was not easy to align the sights correctly. The tiger dashed away without response to the shot, but I hoped for the best as quite frequently no sound is uttered even in case of a mortal wound.

At 11.30 p.m. I heard a peculiar noise which had the sound of a cat-yowl and shortly after a sambur, then a barking deer sounded alarm calls at about the same place. So it was fairly certain the tiger was down, and probably dead or he would not have been at this time (three hours later) within a couple of hundred yards of where fired at.

There was a considerable blood trail and it was evident he had dragged himself along in a crippled state. He was found a short two hundred yards away in a fairly deep nala into which he had collapsed in attempting to reach the bamboo jungle on the further side. It was on hearing the death-cry of a tigress two months later in another block (West Tapti in Betul Forest Division) that I realized what the call had been, for it was a sound not heard on any previous occasion. This tiger measured 8 ft. 10 in. between pegs, and weighed 380 lbs.

2. *7th April* 1925, Taori hamlet: The tigress killed the *boda* tethered for her in the Lapada nala and made great efforts to drag the kill but was defeated by the plaited wire rope. The ·470 soft-nose split bullet hit her rather low behind the near shoulder and made exit beneath the opposite armpit, doing much internal damage but missing the heart. To the shot she fell over, kicking and struggling, so the second barrel (a miss) went into the midst of the wriggles. On this shot she went off at a tremendous pace and tried to scale the high, steep bank, almost a cliff, on the further side of the wide nala bed. I heard her fail to do this and tumble back, roaring and making a great noise. She lay struggling among the leaves but I did not see her as there was much shadow there. The struggles ceased and I heard her heavy breathing. It was about twenty minutes after the shot that she uttered a loud cat-yowl and I knew she had died and at once recalled the sound made by the Junapani tiger. There was no doubt about the sound or the meaning of it. This tigress measured 8 ft. 2½ in. between pegs, and weighed 265 lbs. which was light for her full age and extra large teeth. A pack of about twenty wild dogs ate her carcase the next evening.

3. *15th March* 1926, Biba Block in the Melghat Forest Division: The boda tethered at Chobita, a place where the cart track passes through a grove of large trees, was killed on the night of the 13th

by a wary tiger; or perhaps he found some attraction further away for he gave me a fruitless vigil. The next evening I was delighted about 7.30 to hear the well-known footfalls on the dead leaves below the machan chair. The tiger stood quite three minutes, motionless, listening, observing before going to the carcase. There was crunching of bones followed by a large escape of gas for the weather was hot and the poor boda fast approaching dissolution.

To the shot the tiger grunted, and was seen by the overhead light to be knocked over on to his back with all four legs in the air, but before a second shot could be aimed he was up and away. He could be heard tumbling about among dry leaves not many yards distant and it was certain he was badly wounded. Noise among the leaves continued at the same place for about two hours, after which all was quiet.

The night was not uneventful. A hyaena made a fine feast of the carcase; a cart came rumbling along and would have had to be turned back had it not left by a side track. A flying squirrel rushed up my tree and I almost had him by the tail—a lovely long furred creature, of which there were several in that grove.

About 4 a.m. I awoke from fitful slumbers and heard the laboured breathing of the tiger, so hoped for an easy finishing shot. Daylight was near, the birds beginning to wake up, when I heard the loud dying cat-yowl giving the comforting assurance of no further trouble. There had been some mistake in aim and the ·470 soft-nose bullet struck in the thick part of the neck in front of the shoulder. Here again the place where the tiger lay was only a little over sixty yards and there was no possible doubt as to what I heard, or the meaning of it. He measured 9 ft. 1 in. between pegs, and weighed 380 lbs.

On 18th March a fall from a machan broke my right thigh and wrist, so there was no more shikar for a while!

A Tiger's 'Whisper'!

There is another voice sound of the tiger which not many are likely to have heard—his 'whisper' or 'hist' informing his mate of danger. I could not say positively the warning was uttered by the male, but that can be presumed from the circumstances.

It was a big tiger which slew a boda tethered in the wide nala bed, all smooth basalt boulders and a few flood-torn *jamun* bushes. The machan chair was tied in a small tree growing at the entry of a small ravine into the main nala and it was certain the tiger would pass beneath it on its way to the kill. It was a faulty arrangement, as I knew at the time, but there seemed no other choice.

At 7.30 I heard footfalls in the forest to my front. These came closer and then there was a deep grunt from the tiger which was instantly answered from a hundred yards further back so I knew he had brought his mate to dinner. I was very still, crouched in my chair with cheek on rifle stock. Every rustle of the stealthy approach came to my ears, also the deep throat sound—a sort of threatening rumble—and when much nearer the sniff of the nose being used. Then by slow advance the tiger—I could not dare to

look but knew it was the male as his was the kill—passed under the tree and out on to the sheet rock of the nala. Then came the similar advance of the tigress, without any throat noises, and I heard the rustle of grass as she also passed below and out into the open. Then there was silence. What a grand sight that would have been in daylight, the pair of them standing motionless, listening, gazing.

Now came a slight sound, a sort of 'hist' or whisper of a sound, which was doubtless made by the tiger and from that moment nothing further. I realized I had been winded, or danger otherwise detected. In all probability it was the sudden puff of wind which slanted downwards from the ridge from which the animals had come which carried my scent. Had it been the movement of a portion of my blanket, which I afterwards found had worked loose and hung down a bit behind my chair, there would probably have been a frightened *whoof*, as heard on another occasion, and not that sibilant 'whisper', for such it seemed.

I have successfully taken greater risks of detection than that described, but it is always best to be as high off the ground as possible. The sense of smell of the tiger should not be ignored, and direction of the wind studied when arrangements for a pit or hide are made. That is my experience. That one or other of the pair uttered that whisper of warning is sure, and only under such circumstances could it ever be heard by the sportsman.

Seven days later I killed a tiger and tigress a few miles away from that place. The tigress at 7 p.m. and the tiger at 3 a.m. when his tremendous tug at the kill roused me from light sleep. By the light of the electric torch he was seen standing close to the dead tigress, one more instance to show that animals have no knowledge or realization of death, as such. The kill had been made by the tigress. I was fairly sure that these were the two animals of the incident just related. The male weighed 420 lbs. and measured 9 ft. 3 in. between pegs; the female 255 lbs. 8 ft. 1 in.

No Death-cry by Panthers

None of the many panthers shot by me have uttered this cat-yowl death-cry though there have been occasions when the wound and the circumstances might have given rise to it. An instance may be mentioned. The ·500 modified cordite bullet struck the shoulder of the male panther 3 inches low. To the shot, after a short pause accounted for by a temporary knock-out, the beast rushed off without any voice sound. After a couple of minutes he made tremendous noises, truly prodigious roars, which had a note of pain, and was evidently *in extremis*. After a minute or two of this there was silence, and then a final lesser noise which I was convinced was the end.

In the morning he was found dead 90 yards behind my machan chair at the place the roars came from. On skinning it was found the whole shoulder blown to pieces, lungs damaged, but heart not injured. There was much blood at the place where the body lay when the animal was dying and he had moved a pace in his final

struggles. This is one of several cases I have known when, if the panther has a habit of the cat-yowl on demise in these circumstances, he would have announced his death by such a cry. This animal was old, of stocky build and dark colouring, like most Wynaad panthers of the Manantoddy area. It weighed 92 lb.

BANGALORE, R. W. BURTON,
29*th August* 1948. *Lt.-Col., I.A.* (Retd.).

I have been privileged to see Col. Burton's further notes (above) on the tiger's death-cry, and have been invited to comment thereon.

It is singular that, so far as I know, there is no record of this having been heard previously, yet Col. Burton has heard it no less than three times. Col. Burton's position in the sporting world, and as an observer of nature, is such that no one can have any doubts as to the cry having been uttered and the interpretation thereof. It must certainly have been heard by others, and either ignored, or its significance overlooked.

I personally, so far as I know, have never heard it, and I think it probable that had I done so I would have recognized it as a death-cry. The only noise I have ever heard made by a tiger at the moment of death was a deep, heavy sigh as he expelled his last breath.

It is my belief that a great many animals have a death-cry, and in course of time, more and more of these will be heard, and recognized as such. In fact it would not surprise me if even the giraffe, which has so far never been known to make any sort of noise whatsoever, might yet be capable of a death-cry.

18*th October* 1948. A. A. DUNBAR BRANDER.

4—MAMMALS OF SOUTH TINNEVELLY, MADRAS PROVINCE

The following notes supplementary to my paper on the Mammals of South Tinnevelly (*J.B.N.H.S.* 46, pp. 629-644) may be of interest to your readers.

Rusty Spotted Cat. *Prionailurus rubiginosus.* A beautiful specimen of this small wild cat was killed on 28-8-48 in a tool shed in one of our market gardens at Dohnavur. The four black lines on the head and the rusty spots on the flanks were very clear identification marks. Its head and body measurement was 16 inches. The tail was unfortunately damaged during the skinning. The description ' smaller than a domestic cat ' is correct.

Indian Palm Civet. *Paradoxurus hermaphroditus.* A variety of this animal not specifically mentioned in any publication as far as I know has the majority of its body white with very occasional black hairs. The general appearance from a distance is of a white animal with a bushy white tail. But actually the head, shoulders and front of the front legs down to the second joint was blackish in a specimen shot in our compound on 20-2-47. The pads of the feet were

pinkish, the eyes a dark brown. It was a male. Head and body length 1′ 9″, tail 1′ 9″; weight 5¼ lbs. I have heard from a reliable observer of two more specimens with this style of colouring. One was a baby found at the top of a palmyra palm; the other a full grown animal found dead, both in the foot-hills area.

Rufous Horse-shoe Bat. *Rhinolophus rouxi.* This bat is common both on the plains where it spends the day hanging in the roofs of shut-up houses, and in the hills at 3,000 feet where I found a colony of 30 or more occupying a cave on the hill-side. At dusk I have seen them hawking for white ants beside our house. They appear to be able almost to stand on the ground when picking up a flying white ant as it emerges from its hole, and before it actually takes flight. This bat was omitted from my previous list.

Ceylon Bi-coloured Leaf-nosed Bat. *Hipposideros atratus.* I found four of these hanging under a bed in a shut-up room on the hills at 2,700 feet, on 20-6-48.

Dobson's Wrinkle-lipped Bat. *Taderida tragata.* A single specimen was found dead in one of our houses on 6-9-48. This is an addition to my previous list.

White-tailed Wood-Rat. *Rattus blanfordi.* This is undoubtedly the rat referred to in my article below No. 49 and called by me from the Tamil name 'Rock Rat'. I have since noted the white end to the tail.

C. G. WEBB-PEPLOE.

DOHNAVUR,
S. TINNEVELLY,
16*th September* 1948.

5.—DEATH-CRY IN ANIMALS

It is difficult to know where to draw the line of differentiation between the cry at time of expiring and that of acute perception.

I can recall two cases of the palm squirrel giving a high pitched cry; once when caught by a Sparrow-hawk, and on the other occasion when cornered in the hollow of a tree by my tame mongoose. This was from fright, but to those of us who have done any amount of pig-sticking, the death cry of a really gallant boar will be nothing new. I have, not once but a dozen times, experienced a really good fighting pig that came in and charged at sight and took spear thrust after spear thrust without a sound, on going down on his knees or turning over just before death, emit a high pitched squeal that could only be taken as a death-cry. I do not refer to the boar held down with the spear, or turned over, but to those gallant fighters who take all the punishment without a murmur and only squeal as they die.

Dunbar Brander makes reference to jackals. In the old days in Bihar while hunting jacks with polo sticks, a beast would often emit a long one-note howl on being hit on the head and knocked out. This may also be termed a death-cry.

An interesting feature of this cry is, that it attracts others if near by, and the tribe of 'Jackal Callers' use it to bring jacks out of cover.

Whatever the cause, it has some significance in the 'Geedar' language.

8 DALHOUSIE SQUARE, EAST,
CALCUTTA, A. ST. J. MACDONALD.
27*th August* 1948.

6.—FUNERAL OF A WEASEL

(*Reprinted from* 'THE FIELD' *of March* 27, 1948)

'SIR,—Here is the account of the funeral of a weasel. Readers who might be inclined to dismiss the story as incredible should remember that many stories written in Gaelic (the Irish national language) contain references to the tradition that weasels mourn and bury their dead.

While engaged gathering sticks along the main Castlefin-Raphoe road at Sandymills, Mr. William Doherty, of Clogfin, Ballindrait, observed a weasel emerging from a ditch, carrying something in its mouth. On Mr. Doherty drawing nearer, the weasel dropping what it carried, ran off. Mr. Doherty then saw that it was the body of a dead weasel. Remembering how in his young days he had heard the old people talk of the belief that weasels held funerals, he decided to wait and watch. Concealing himself on the far side of the road some distance from the spot he awaited events.

Within a few minutes, a weasel jumped out of a hole in the ditch, gave a quick glance around and beat its forefeet on the ditch. In a few seconds no less than eighteen weasels appeared and bunched behind their leader.

Two of the weasels approached the body of their dead friend, slowly raised it and set off with it, keeping to the grass margin of the road. All the other weasels, two abreast, followed in sad procession. They moved at a slow pace down the road until they had gone almost one hundred yards when the 'cortege' entered a field by a gate and proceeded to a sand pit, where the dead weasel was interred.

Mr. Doherty regrets he had not a camera with him to record the event.'

OMAGH. H. B. MCCANN.

[There are many references in Gaelic, Celtic and Norse literature to the burial by weasels of a dead companion. It should be remembered that in ancient times the weasel was regarded as a fairy animal, or as the property of fairies, and was often credited with superhuman powers, and accounts in the ancient literature should be read in this light. There can, however, be no doubt whatever that weasels do on occasion bury their dead. Instances have been recorded previously in 'The Field' (notably by Buckland reporting a gamekeeper in Yorkshire, and Harting reporting a gamekeeper in Berkshire) and there are also records in 'The Gentleman's Magazine',

An instance has also been witnessed recently by a gamekeeper in Cumberland.

There appear to be no records of stoats burying their dead, but the habit is not confined to weasels. Some twenty years ago Brian Vesey-FitzGerald recorded the burial of a dead badger—this account was later included in his 'A Country Chronicle'—and badger funerals have also been witnessed in Britain by Col. R. Meinertzhagen (reported in 'The Field') and J. B. Smythe. There are also records of badger funerals from Russia and Sweden. Bears will also bury their dead. Three such funerals have been recorded from Russia; an account is given by A. K. Arseniev in which dead foliage and wood was piled over the grave after interment—EDS.']

7. DOG–FOX CROSSES

Relying on correspondence in 'The Field' I have stated in the August *Journal* (pp. 728–729) that unions between the English fox and domestic dog are fertile.

In a letter to 'The Field' dated the 20th November 1948 another correspondent remarks that the dog and fox are not of the same genus though they belong to the family *Canidae*, and there is no authentic case of the European or any other fox crossing with the dog.

The editor of 'The Field' confirms that the correspondent is correct and that it is impossible (despite all the rumours about dog-fox hybrids) for the two to inter-breed. This does not mean however, says the editor, that they will not couple.

BANGALORE,
16*th December* 1948.

R. W. BURTON,
Lt.-Col., *I.A.* (Retd.)

8. OCCURRENCE OF THE LARGE HIMALAYAN MALKOHA [*RHOPODYTES T. TRISTIS* (LESS.)] IN KHULNA SUNDERBANS.

During my trip to the Sunderbans in the year 1944 when the launch 'Harrier' (placed at my disposal through the courtesy of the then D.F.O.) was halting at Mankiduania Khal between August 7 and 8 I snatched a few hours for bird-watching from a small boat along the adjacent water channels, penetrating into the thick forest consisting mainly of trees like Sundri (*Heritiera minor* Roxb.), Gengwa (*Excoecaria agallocha* Linn.) and Keora (*Sonneratia apetala* Ham.). The Kera trees growing on the banks of Mankiduania Khal, being generally of considerable size, were noticed to harbour many interesting species of birds. Large flocks of *Dicaeum cruentatum* (Linn.) moving up from all directions gathered around the taller trees and plunged into lively activity, quarrelling, chirping and searching for food among the leaves. The sky was overcast and it was nearing dusk, but as my boat drew nearer I could watch them closely. In the failing light the movement of an unusual-looking

bird in the topmost branch of another Keora tree caught my attention and I shot it. It was a great surprise to find that the specimen was a Green-billed Malkoha [*Rhopodytes tristis* (Less.)]. It seemed to be an immature bird and measured as follows:

Total length 435 mm; wing 148 mm; tail 280 mm; tarsus 41 mm; culmen 30 mm.

Colours of soft parts: iris brown; orbital skin crimson.

From the darker colouring of its upper plumage, richly glossed with green, the ochreous tinge of the under parts as also the oblique shape of the white tips to its tail-feathers it appears to correspond with the typical race (*R. t. tristis*).

Evidence of the distribution of the species in Central and South Bengal is rather obscure. Jerdon's mention of Lower Bengal appears vague. Some confusion was created by Blyth stating, on the testimony of Mr. Frith, that *Ph. sumatranus* occurs in the Sunderbans of Bengal (*J.A.S.B.* xii. p. 246). At that time, however, Blyth presumed *Cuculus sumatranus* of Raffles, *M. diardi* of Lesson and *Ph. tristis* to be synonymous. The point was cleared up by Blyth's subsequent treatment of these three as separate species (Catalogue of Birds in the Indian Museum) and his specific statement that of these only *tristis* inhabits Bengal and some other areas within Indian limits.

Stuart Baker in *F. B. I., Birds*, 2nd ed., mentions Bengal as type-locality of the species. In his *Nidification* he refers to its distribution in Eastern Bengal, where no doubt the species is found; e.g., not uncommon in Dacca and surrounding areas (Simson, *Ibis*, VI, 1862, p. 87). In North Bengal the species is a well-known inhabitant of the lower Eastern Himalayas, frequenting foot-hill forests and those in warm humid valleys.

50 Kailas Bose Street,
Calcutta,
23*rd July* 1948. SATYA CHURN LAW,
M.A., Ph.D., F.N.I.

[Lowther (*J. B. N. H. S.* 41, p. 542) records this species as fairly common in the Manbhum District, Bihar, adjoining western Bengal, nesting in July and August.—Eds.]

9. GREEN PIGEON IN A SWAMP

Frend's note in the *Journal* of April 1948 (Vol. 47) recalls to memory Green Imperial Pigeon at Sahmaw, Burma, coming down from the high tree-tops which they normally frequent, to either drink the brine or eat the deposit of sodium carbonate that came from a salt spring by the Sahmaw River. ('Sahmaw' incidentally means salt spring). The Kachins expressed no astonishment at seeing fifteen or twenty of these birds hopping around where the ooze took place, and informed me it was usual both in the mornings and evenings to see them come down and drink here.

In the U.P. I have seen the Common or Bengal Green Pigeon come down to a tank to drink, and also feeding from the ground below a *Ficus* tree picking up figs.

c/o SURAJMULL NAGARMULL,
8 DALHOUSIE SQ., EAST, A. ST. J. MACDONALD.
CALCUTTA,
27th August 1948.

10. ARRIVAL OF WAGTAILS IN MADURA DISTRICT, SOUTH INDIA

I have read with great interest the dates of the arrival of wagtails in Upper Assam in the *Journal* (Vol. 47, No. 1). Mrs. Cantlay who has resided in these hills (High Wavy) for many years has kept a record of the dates of the arrivals of the first wagtails after the rains, and she has been good enough to let me use these as they make a good contrast with the dates quoted by your correspondent.

It is of interest to note that one unmistakable bird (due to having a very prominent white feather in its tail) returned to this garden four years running! I will give the dates and years below of the first arrivals :—

1940—2 September
1941—3 September
1942—4 September
1943—4 September
1944—9 September
1945—No record
1946—5 September
1947—3 September

The species concerned is the Grey Wagtail (*Motacilla cinerea*) The dates are interesting since the birds seem to arrive here earlier than in Assam which is nearer to their nesting area.

HIGH WAYS ESTATE,
CHINNAMANUR P.O., A. F. HUTTON.
MADURA DIST.,
1st June 1948.

11. MORNING AND EVENING SONG OF BIRDS

This year the spot selected for recording the serial succession of the morning and evening song of birds was Pokhri Bal, latitude ca. 34°N., longitude, ca. 74°E. This place is situated at the foot of the eastern side of Hari Parbat hill (5,700 ft.) A part of the Dal Lake runs in towards the land and there are a number of islets covered with willows, orchards and tall poplars; several beds of bulrushes lie in amongst the islets affording a place of safety for water-birds.

Towards the land there are gardens of almond on a raised level. The chinars, acacias, willows, poplars and mulberries, make the place dense with trees. There are here a number of sheds where people can spend the night if they wish. A spring closeby is sacred to the Hindus.

The sky was serene and clear of clouds and the distant mountain ranges were steeped in sombre hue. The peak of Mahadiv (13,013 ft.) covered with snow shed lustre when the goddess of Dawn began to unvail herself. Rare are such occasions, when man can merge his thoughts with Nature. The songs proceeded thus:

Indian Standard Time.

3–5	a.m.	Ringdove (*Streptopelia decaoto decaoto*)
3–45	,,	Reed-Warbler (*Acrocephalus stentoreus brunnescens*)
4–5	,,	Chirping of Mynas (*Acridotheres tristis tristis*) Ringdove.
4–15	,,	Ringdove from a different quarter.
4–20	,,	Moorhen (*Gallinula chloropus parvifrons*)
4–21	,,	Cuckoo (*Cuculus canorus*) distant.
4–25	,,	Paradise Flycatcher (*Tersiphone paradisi leucogaster*) Golden Oriole (*Oriolus oriolus kundoo*) Chirping of mynas. Another Golden Oriole.
4–30	,,	Golden Oriole continuing.
4–31	,,	Another Golden Oriole.
4–36	,,	Chirping of mynas.
4–37	,,	Tickell's Thrush (*Turdus unicolor*) Golden Oriole.
4–41	,,	Tickell's Thrush; Golden Oriole.
4–42	,,	Thrush. Cuckoo continued for 3½ mins. with occasional breaks of 5 secs. Golden Oriole; Tickell's Thrush.
4–50	,,	Cuckoo; Thrush; Golden Oriole.
4–57	,,	Songs in full swing: Ringdove; Cuckoo; Thrush; Golden Oriole.
4–58	,,	White-cheeked Bulbul (*Molpastes leucogenys leucogenys*)
5–00	,,	Cuckoo stopped.
5–1	,,	Golden Oriole.
5–4	,,	Golden Oriole; Thrush; Sparrow (*Passer domesticus parkini*)
5–12	,,	Golden Oriole; Thrush; call of the Thrush. Jackdaw (*Corvus monedula*).
5–13	,,	Distant Cuckoo.
5–16	,,	Distant song of Ringdoves.
5–26	,,	Kingfisher (*Alcedo atthis pallasii*) flew to its nest. Kite flew.
5–30	,,	Ringdove in the distance.
5–36	,,	Reed-Warbler.
5–38	,,	Pheasant-tailed Jacana (*Hydrophasianus chirurgus*) A cock sparrow on the electric wire danced in front of his hen.
5–55	,,	Shrike (*Lanius schach erythronotus*)

6–5	a.m.	Hoopoe (*Upupa epops epops*)
6–10	,,	SUNRISE.
7–10	p.m.	SUNSET. Golden Oriole; Ringdove; Bulbul
7–15	,,	Ringdove; Sparrow.
7–18	,,	Ringdove again; Sparrow continuing.
7–19	,,	Bulbul; Ringdove stopped.
7–20	,,	Kingfisher.
7–21	,,	Moorhen.
7–25	,,	Ringdove.
7–35	,,	Two Ringdoves.
7–39	,,	Call of Thrush.
7–41	,,	Paradise Flycatcher; Ringdove.
7–44	,,	Shrike; Paradise Flycatcher continued.
7–48	,,	Call of Thrush.
7–49	,,	Cuckoo continued for 4 min.
8–10	,,	All quiet.

CENTRAL HIGH SCHOOL,
FATEH KADAL, SRINAGAR, SAMSAR CHAND KOUL.
KASHMIR.

[Unfortunately the date is omitted from the note. Previous observations on the same lines, recorded by Mr. Koul on 24th May 1947, are published in volume 47 of the *Journal*, pp. 386–7.—EDS.]

12. SOME INTERESTING BIRDS OF THE GIR AND GIRNAR, KATHIAWAR

With the kind permission of the Junagadh State authorities I was able to spend a happy week of bird study in the Gir forest from May 22 to May 30, 1947. The Gir is situated in the south of Kathiawar. It is approximately 500 sq. miles and consists of a plateau formation of hills amidst dry deciduous forest. When I reached Sasan I found the forest unusually green, the result of an early rainfall in April. Consequently the bird life was plentiful and mostly in full breeding condition. A chorus of sweet avian music could be heard resounding throughout the forest area.

The Girnar mountain is about 40 miles west of Gir forest near the town of Junagadh.

I did not come across the Grey Hornbill in the Gir inspite of the fact that it is resident. I am afraid it is being persecuted by local people because of its supposed medicinal value.

The Girnar hill unexpectedly contained less bird life than the Gir forest and I was surprised at the absence of many birds seen in the Gir area.

The following is the list of birds seen :—

1. Jungle Crow (*Corvus macrorhynchos*). Common.
2. House Crow (*Corvus s. splendens*). Common.
3. Tree Pie (*Dendrocitta vagabunda*). A few pairs seen hunting and in unusually bright plumage.

4. Grey-Tit (*Parus m. stupae*). Common throughout the forest and seen nesting in hollows of trees of which the forest is full.

5. Jungle Babbler (*Turdoides somervillei*). Fairly widespread and common.

6. Scimitar Babbler [*Pomator hinus* (*horsfieldi*)]. One bird seen on hill-side.

7. White-throated Babbler (*Dumetia hyperthra albogularis*). Seen in pairs and in groups usually near waterside. Resident.

8. Yellow-eyed Babbler (*Chrysomma sinensis*). A few birds seen in grassy forest, not far from water.

9. Central Indian Iora (*Aegithina tiphia humei*). Not uncommon. Seen in the flatter forest areas and in thorny scrub. A few pairs found breeding.

10. Red-vented Bulbul (*Molpastes h. pallidus*). Common.

11. Magpie Robin (*Copsychus saularis*) Abundant. Many nests found. Heard in full song.

12. Indian Robin (*Saxicoloides fulicata cambaiensis*). A few birds seen in open scrub. One pair seen nesting.

13. Tickell's Flycatcher (*Muscicapula tickelliae*). Fairly common and many nests found. Birds in full breeding condition; preferring thick forest near streams and ravines.

14. Paradise Flycatcher (*Tchitrea paradisi*). A number of pairs seen breeding in ravines; also away from ravines in flat country. Others seen in courtship.

15. White-browed Fantail Flycatcher (*Rhipidura aureola*). A number of pairs seen, but apparently less common. Birds found on nest with eggs.

16. Small Minivet (*Pericrocotus peregrinus*). Seen in pairs commonly on hill-side and in parties in thorny scrub jungle in lower ground.

17. Black-headed Cuckoo-Shrike (*Lalage sykesii*). A few pairs seen near camp on hill-side, and one pair found nesting on a teak tree.

18. Large Cuckoo-Shrike (*Grauculus javensis*). Seen frequently on the topmost branches of trees preferring larger unfoliated trees. Saw fledglings following parent birds. The conspicuous call is a harsh one, and which readily identifies its presence.

19. Black Drongo (*Dicrurus macrocercus*).

20. Grey Drongo (*Dicrurus longicaudatus*)

21. Tailor Bird (*Orthotomous sutorius*).

22. Franklin's Wren-Warbler (*Franklinia gracilis*).

23. Jungle Wren-Warbler (*Prinia sylvatica*).

24. Common Myna (*Acridotheres t. tristis*). Forest full of them. Breeding.

25. Jungle Myna (*Acthiopsar fuscus*). A number of birds seen feeding with Common Myna.

26. Dusky Crag Martin (*Riparia concolor*). A number of pairs seen near top of Girnar hill and close to Uperkot.

27. Sykes's Striated Swallow (*Hirundo daurica erythropygia*). Sporadic pairs seen in forest near hill tops and near river beds. One pair found building nest in a rock cavity on hill-side.

28. White-eye (*Zosterops palpebrosa*). Not uncommon. Found nesting on trees overhanging ravines, fairly close to water-hole.

29. Pitta (*Pitta brachyura*). Widespread and heard calling frequently. One pair had started to nest.

30. Pied Woodpecker (*Dryobates mahrattensis*). Seen more frequently in thorny scrub and mixed deciduous forest.

31. Pigmy Woodpecker (*Dryobates hardwickii*). One pair found nesting in teak with 3 eggs, quite close to camp. Other pairs seen frequently in forest often sunning themselves in the early morning on dry rotten trees. Not very shy. I believe the male incubates at night, the female by day.

32. Golden-backed Woodpecker (*Brachypternus benghalensis*). Fairly common throughout the forest. Young birds seen, and used nesting holes found at the height from 15 to 45 feet. Resident.

33. Coppersmith (*Megalaema h. lutea*). Fairly common and one pair found breeding next to camp bungalow which had three young ones in nest.

34. Common Indian Cuckoo (*Cuculus canorus*). Seen occasionally but heard fairly frequently. Breeding ?

35. Hawk-Cuckoo [*Hierococcyx (varius)*]. Seen and heard at base of Girnar hill.

36. Pied Crested Cuckoo (*Clamator jacobinus*). Seen at base of Girnar hill and heard calling.

37. Blossom-headed Parakeet (*Psittacula cyanocephala*). Fairly common in forest area and is a resident species.

38. Indian Roller (*Coracias benghalensis*). One pair seen near camp regularly and was suspected of nesting.

39. Green Bee-eater (*Merops orientalis orientalis*). Found nesting on ravine banks in small colonies and singly. Fairly common.

40. Common Kingfisher (*Alcedo atthis*). Seen frequently on running streams and evidently breeding. A nest discovered in a small cave next to water, had five young ones.

41. White-breasted Kingfisher (*Halcyon smyrnensis*). Seen frequently on banks where I found it nesting. Five-egg clutches normal.

42. Crested Swift (*Hemiprocne coronata*). One bird seen singly over forest area in the hills for two days consecutively hawking for insect life, about 15 miles from camp.

43. Fish-Owl (*Ketupa z. leschenaulti*). Not uncommon and seen amongst tall trees near running streams and dry sandy beds. Saw two fledglings.

44. Spotted Owlet (*Athene brama*). Frequently seen at dusk.

45. Black Vulture (*Sarcogyps calvus*). A few pairs but common.

46. Griffon Vulture* (*Gyps fulvus*). Some pairs seen on the crags. Girnar.

47. White-backed Vulture (*Pseudogyps benghalensis*). Young birds in full plumage. Girnar.

48. Neophron (*Neophron percnopterus*). Common,

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* Or Long-billed (*G. indicus*) ?, or both ?—Eds.

49. Shahin Falcon (*Falco peregrinus peregrinoides*). One seen flying towards Girnar mountain.

50. Bonelli's Eagle (*Hieraetus fasciatus fasciatus*). Adult and immature bird seen near hill-side close to camp.

51. Indian Crested Hawk-Eagle (*Spizaetus c. cirrhatus*). A number of specimens seen singly and near water-holes. often mobbed by crows.

52. Serpent Eagle (*Spilornis cheela*). Two specimens seen which might be breeding.

53. Common Kite (*Milvus m. govinda*). Common.

54. Shikra (*Astur badius dussumieri*). Sometimes seen.

55. Indian Honey-Buzzard (*Pernis ptilorhynchus ruficollis*). A few pairs seen together. One pair collected was in full breeding condition.

56. Green Pigeon (*Crocopus phoenicopterus*). Fairly common and seen breeding in secluded valleys.

57. Spotted Dove (*S. c. suratensis*). Abundant.

58. Little Brown Dove (*S. s. cambaiensis*). Common.

59. The Ring Dove (*Streptopelia d. decaocto*). Seen in open forest.

60. Painted Sandgrouse (*Pterocles indicus*). Seen in small flocks in openings surrounded by forest.

61. Jungle Bush-Quail (*Perdicula a. asiatica*). Fairly common in forest area. Resident. This may prove to be a new subspecies.

62. Rock Bush Quail (*Perdicula argoondah*). Found on outskirts of forest where thorny scrub and forest trees meet.

63. Grey Partridge (*Francolinus pondicerianus*).

64. Painted Francolin (*Francolinus pictus*).

65. Red-wattled Lapwing (*Lobivanellus i. indicus*). Surprisingly seen nesting in forest on rocky bed of ravine. Most unusual.

66. Yellow-wattled Lapwing (*Lobipluvia malabarica*). Seen breeding in open spaces in forest and outskirts. One pair with eggs in compound.

67. White-necked Stork. (*Dissoura episcopus*). A few birds seen on tall trees in forest and one nest found. Uncommon.

DHARMAKUMARSINHJI.

BHAVNAGAR,
8*th October* 1948.

13.—REMARKS ON 'AGGRESSIVE DEMONSTRATION BY RUSSELL'S VIPER'

I have read with interest Mr. A. A. A. Fyzee's note in Vol. 47, No. 2, at pages 388–89. From what I have observed I am also inclined to believe that Russell's Viper, as suggested by Mr. Fyzee, is conscious of its own potency. I have noticed, and it is a well-known fact, that it is indifferent to, and almost contemptuous of, man's presence. The following incident illustrating its temperament might interest you.

Some years ago when I was stationed at Navibunder on the west coast of Kathiawar, I was one evening watching flamingoes in a nearby creek from a hard and rising ground. My attention was drawn by a small snake hissing in front of me. It was a Russell's Viper hissing violently, writhing and moving from side to side. I could see that it wanted to move in my direction, but its progress was blocked by my presence. The snake was hardly a foot and a half long, but it displayed such a violent attitude that I thought discretion was the better part of valour and retreated a couple of steps. No sooner I did it than the reptile moved in my direction and disappeared into a hole. Then I realised that I was blocking its way to its home. What surprised me was its insistence to go its own chosen way and not to escape in any direction on my approach. By such bullying tactics, to use legal parlance, it asserted its right of way.

V. M. VASU.

28 (80-A) KURLA ROAD,
ANDHERI, BOMBAY,
10*th June* 1948.

14—DEVELOPMENT OF FISHERIES OF THE PERIYAR LAKE*

The Periyar Lake is a permanent water situated within the Travancore territory but adjoining the Madura district of the Madras Province, at an altitude of about 3,000 feet above M.S.L. in a wild country surrounded on all sides by magnificent well-wooded hills in which elephant, bison and other wild animals roam about. The area of the water-spread at F.S.L. of 152 feet is 10·2 square miles, and it has an average supply of ten million cubic feet of water estimated to yield about 78 million pounds of fish.

The fishery of the lake belongs to the Madras Government and has been leased to the Peermade Game Association, who in turn permit only angling by licencees. With a view to develop the fishery a survey of the indigenous fish fauna was conducted in 1946. The following species were listed:—

1. *Anguilla bengalensis* (Gray & Hardw.), 2. *A bicolor* McClell., 3. *Heteropneustes fossilis* (Bloch), 4. *Callichrous bimaculatus* (Bloch), 5. *Silundia sykesi* Day, 6. *Macrones cavasius* (Ham), 7. *M. vittatus* (Bloch), 8. *Glyptothorax madraspatanum* Day, 9. *Garra lamta* (Ham.), 10. *G. mullya* (Sykes), 11. *Lepidocephalus thermalis* (C. & V.), 12. *Nemachilus evezardi* Day, 13. *Lepidopygopsis typus* Raj, 14. *Barbus amphibius* (C. & V.), 15. *B. arulius* (Jerdon), 16. *B. curcuma* (Ham.) 17. *B. melanamphyx* (Day), 18. *B. melanostigma* (Day), 19. *B. micropogon periyarensis* Raj, 20. *B.* (*Tor*) *khudree* (Sykes), 21. *B. ophicephalus* Raj, 22. *B. pinnauratus* (Day), 23. *Rasbora daniconius* (Ham.), 24. *Barilius bendelisis* (Ham.), 25. *B. bakeri* Day,

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

26. *B. gatensis* (C. & V.)., 27. *Danio aequipinnatus* (McClell.). 28. *Chela boopis* Day, 29. *Notopterus notopterus* (Pallas), 30. *Aplocheilus lineatus* (C. & V.), 31. *Glossogobius giuris* (Ham.), 32. *Rhynchobdella aculeata* (Bloch), 33. *Mastacembelus armatus* (Lacép), 34. *Ophicephalus striatus* (Bloch), and 35. *O. gachua* Ham.

The commonest fish in the lake is the Mahseer, which grows to a size of 20-30 pounds. Mahseers of an average weight of 8 pounds are captured throughout the year by rod and line using boiled tapioca, minnows and rice-paste as bait. The Mahseer breeds in the lake during the monsoons, extending from April to October. The breeding areas are shallow gravelly beds or places with thick vegetation near the several streams that feed the lake.

In order to improve the quality of the fishery by stocking semi-exotic species, the quick-growing carp *Catla catla* (C. & V.) and the Milkfish, *Chanos chanos* (Forskal), were introduced into the lake for the first time in October 1946 and April 1947 respectively. Catla was brought from the Godavari, 800 miles away. It is expected to breed and multiply in the favourable environs of the lake. The Milkfish was collected from the sea around Krusadai Island, Gulf of Manaar, where the salinity at the time of collection was 17·49°/°° ; and transported over a distance of 200 miles before stocking in the lake. Though it is not expected to breed in the lake, its thriving is being watched with interest. The development of this lake fishery is also expected to enrich the fisheries of the several irrigation tanks in the Madura district which are fed by the Periyar System.

INLAND FISHERIES OFFICE, P. I. CHACKO
8 ORMES ROAD, KILPAUK, MADRAS,
17*th June* 1948.

15.—' TERMITE FUNGI '

With reference to the note by Mr. C. McCann in Vol. 46 of the *Journal* (p. 739), Prof. S. R. Bose of Calcutta, to whom the specimens were sent, has kindly identified the species as *Entotoma microcarpum* B. & Br. It is stated to be found in termite-eaten wood.

114, APOLLO STREET,
BOMBAY, EDITORS.
18*th August* 1948.

16.—INTRODUCTION OF FOREIGN INSECTS WITH IMPORTED GRAINS.

Acute shortage of food grain as a result of the last war, forced importation of grains from outside to avert famine conditions. Till recently it was not appreciated that the imported grains might as well introduce foreign insects which will create a permanent menace to our storage problems. Thousands of tons of grains were imported and distributed throughout the country but unfortunately even the

ordinary precautions followed in allowing the entry of a small cotton sample, were not taken while introducing these large consignments. This has resulted in the importation of a number of reputed pests.

Our attention was first drawn to this problem towards the close of 1945 by a severe outbreak of *Plodia interpunctella* H., in one of the wheat godowns at Bombay. Our observations also revealed a few more insects namely *Sitophilus granarium* L. and *Tribolium confusum*, which were later recorded also from various other godowns.

Due to the introduction of some hardy insects such as *Trogoderma granaria* E. and *Plodia interpunctella* H., the storage problem at present is getting difficult. Bombay being the main port of India, most of the grains are being unloaded and stored here. Thus Bombay has become the nucleus for the propagation of these pests.

With a view to keeping some watch on the imported material the grains were inspected while in the steamers and a report made to the Food Controller, Bombay, about the insect pests. The information collected so far is presented here to expose the implications of this problem. (See tabulated statement overleaf.)

The inspections were started in January 1947. During the last 15 months, 192 steamers with food grains were inspected at Bombay and some details are given in the following statement.

Obviously some grains such as Burma rice, American maize and African wheat were received in an infested condition while others were practically sound. The infestation in other grains wherever noticed was not found to exceed 0.3% which indicates that probably the infestation was picked up during transport. If it be so, the problem becomes quite easy and considerable losses and the introduction of new insects would be prevented by simply disinfecting the ship before loading the grains. At the same time fumigation of stacks before unloading at Bombay, will be an effective preventive measure which is quite practicable because the holds of ships are practically airtight. It is suggested that necessary precautionary steps should be taken up at once to avoid complexities in the storage problem and the establishment of new insect pests in this province.

We acknowledge with gratitude the help and co-operation afforded by Mr. B. D. Deshpande, M.AG., Food Controller, Bombay, for carrying out these observations.

COLLEGE OF AGRICULTURE,
POONA (5)
11*th August* 1948.

K. N. TREHAN
S. V. PINGLE

STATEMENT SHOWING THE CONDITION OF GRAINS IMPORTED BETWEEN 1-1-1947 AND 1-3-1948

S. No.	Commodity imported	Country from which imported	No. of steamers inspected	Type of storage on steamer	Condition of grain at the time of import	Degree of infestation and No. of cases where infestation noticed	Insects responsible for damage in the steamer	Remarks
1	Kangani Rice.	Pakistan ...	8	In bags ...	Sound ...	Infestation noted in two cases, not exceeding 0·2%.	**Ephestia cautella* W. *Tribolium castaneum* H. *Sylvanus surinamensis* L.	
2	Burma rice and paddy.	Burma ...	8	In bags ...	Infested ...	Infestation noted in seven cases, varying between 0·3% to 2·1%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Sylvanus surinamensis* L. *Tenebroides mauritanicus* L. *Corcyra cephalonica* St. *Loemopholoeus minutus* O. *Ephestia cautella* W. *Sitotroga cerealella* O.	
3	Egyptian rice.	Egypt ...	3	In bags ...	Sound ...	Infestation noted in one case, not exceeding 0·2%.	**Tyrogiyphus* spp. *Tribolium castaneum* H.	
4	Brazil rice ...	Brazil ...	2	In bulk ...	Sound ...	Nil.	Nil.	
5	Yellow and white Millo (red and white *jowar*).	America ...	36	In bulk ...	Frequently damaged by moisture.	Infestation noted in one case, not 0·1%.	**Tyroglyphus* spp. *Sylvanus surinamensis* L. *Sitophilus oryza* L.	This grain was observed mostly damaged by moisture and fungus, especially the top and the side layers in various holds. Heating was noticed invariably in all cases.

6	*Jowar*, *Bajri* and other millets.	America, Iran and Arabia.	8	In bags ...	Frequently damaged by insects.	Infestation noted in six cases, not exceeding 0·5%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Tenebroides mauritanicus* L.	
7	American wheat.	Canada U.S.A.	18	In bulk ...	Cool and sound.	Infestation noted in two cases, not exceeding 0·1%.	**Plodia interpunctella* H. *Sitophilus oryza* L. *Tribolium castaneum* H.	
8	Australian wheat.	Australia ...	16	In bulk and bags.	Cool and sound.	Infestation noted in one case, not exceeding 0·3%.	*Sitophilus oryza* L. *Tribolium castaneum* H.	
9	Turkish wheat	Turkestan	7	In bulk and bags.	Sound ...	Infestation noted in five cases, not exceeding 0·2%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Corcyra cephalonica* St.	Invariably this wheat was found mixed with weed seeds such as of *Lollium* spp. *Datura* spp. and others. Some of these are said to have narcotic effect on man.
10	African wheat	South Africa.	13	In bulk and bags. Mostly in bags.	Infested ...	Infestation noted in eleven cases, varying between 0·3% to 1·0%.	**Plodia interpunctella* H. *Corcyra cephalonica* St. **Ephestia cautella* W. *Sitophilus oryza* L. *Tribolium castaneum* H. **Tyroglyphus* spp.	
11	Sind wheat...	Pakistan ...	3	In bags ...	Sound ...	Nil.	Nil.	
12	Wheat flour.	U.S.A. ...	45	In cloth bags.	Mostly sound.	Infestation noted in seven cases.	**Plodia interpunctella* H. *Corcyra cephanolica* St. *Ephestia cautella* W. *Tribolium castaneum* H. **Tribolium confusum* J.Du.V.	

STATEMENT SHOWING THE CONDITION OF GRAINS IMPORTED BETWEEN 1-1-1947 AND 1-3-1948

S. No.	Commodity imported	Country from which imported	No. of steamers inspected	Type of storage on steamer	Condition of grain at the time of import	Degree of infestation and No. of cases where infestation noticed	Insects responsible for damage in the steamer	Remarks
1	Kangani Rice.	Pakistan ...	8	In bags ...	Sound ...	Infestation noted in two cases, not exceeding 0·2%.	**Ephestia cautella* W. *Tribolium castaneum* H. *Sylvanus surinamensis* L.	
2	Burma rice and paddy.	Burma ...	8	In bags ...	Infested ...	Infestation noted in seven cases, varying between 0·3% to 2·1%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Sylvanus surinamensis* L. *Tenebroides mauritanicus* L. *Corcyra cephalonica* St. *Loemopholoeus minutus* O. *Ephestia cautella* W. *Sitotroga cerealella* O.	
3	Egyptian rice.	Egypt ...	3	In bags ...	Sound ...	Infestation noted in one case, not exceeding 0·2%.	**Tyroglyphus* spp. *Tribolium castaneum* H.	
4	Brazil rice ...	Brazil ...	2	In bulk ...	Sound ...	Nil.	Nil.	
5	Yellow and white Millo (red and white *jowar*).	America ...	36	In bulk ...	Frequently damaged by moisture.	Infestation noted in one case, not 0·1%.	**Tyroglyphus* spp. *Sylvanus surinamensis* L. *Sitophilus oryza* L.	This grain was observed mostly damaged by moisture and fungus, especially the top and the side layers in various holds. Heating was noticed invariably in all cases.
6	*Jowar, Bajri* and other millets.	America, Iran and Arabia.	8	In bags ...	Frequently damaged by insects.	Infestation noted in six cases, not exceeding 0·5%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Tenebroides mauritanicus* L.	
7	American wheat.	Canada U.S.A.	18	In bulk ...	Cool and sound.	Infestation noted in two cases, not exceeding 0·1%.	**Plodia interpunctella* H. *Sitophilus oryza* L. *Tribolium castaneum* H.	
8	Australian wheat.	Australia ...	16	In bulk and bags.	Cool and sound.	Infestation noted in one case, not exceeding 0·3%.	*Sitophilus oryza* L. *Tribolium castaneum* H.	
9	Turkish wheat	Turkestan	7	In bulk and bags.	Sound ...	Infestation noted in five cases, not exceeding 0·2%.	*Sitophilus oryza* L. *Tribolium castaneum* H. *Corcyra cephalonica* St.	Invariably this wheat was found mixed with weed seeds such as of *Lollium* spp. *Datura* spp. and others. Some of these are said to have narcotic effect on man.
10	African wheat	South Africa.	13	In bulk and bags. Mostly in bags.	Infested ...	Infestation noted in eleven cases, varying between 0·3% to 1·0%.	**Plodia interpunctella* H. *Corcyra cephalonica* St. **Ephestia cautella* W. *Sitophilus oryza* L. *Tribolium castaneum* H. **Tyroglyphus* spn.	
11	Sind wheat...	Pakistan ...	3	In bags ...	Sound ...	Nil.	Nil.	
12	Wheat flour.	U.S.A. ...	45	In cloth bags.	Mostly sound.	Infestation noted in seven cases.	**Plodia interpunctella* H. *Corcyra cephalonica* St. *Ephestia cautella* W. *Tribolium castaneum* H. **Tribolium confusum* J.Du.V.	

STATEMENT SHOWING THE CONDITION OF GRAINS IMPORTED BETWEEN 1-1-1947 AND 1-3-1948—(*contd.*)

S. No.	Commodity imported	Country from which imported	No. of steamers inspected	Type of storage on steamer	Condition of grain at the time of import	Degree of infestation and No. of cases where infestation noticed	Insects responsible for damage in the steamer	Remarks
13	Brown and white maize.	America ...	14	In bulk ...	Infested ...	Infestation noted in twelve cases, varying between 0·4% to 3·0%.	**Plodia interpunctella* H. *Ephestia cautella* W. *Silotroga cerealella* O. **Pyroderces rileyi* W. **Sitophilus oryza* L. **Sitophilus granarium* L. *Tribolium castaneum* H. **Tyrogloyphus* spp.	
14	Barley ...	America and Africa.	11	In bulk and bags.	Unhusked and sound.	Infestation noted in three cases. Damage up to 2·0%.	*Sitophilus oryza* L. **Sitophilus granarium* L. *Tribolium castaneum* H. *Rhizopertha dominica* O.	

In all 192 steamers were inspected and in each there were 4–6 holds for storing the grains. Each steamer had a capacity of 6,000–8,000 tons of grains (65,000–90,000 bags). Inspection was done before and during the process of unloading. The percentage of damage was estimated from samples from various layers by counting 200 gm. from each sample. Insects marked with asterisks were not recorded in Bombay Province up to 1942.

17.—ON THE OCCURRENCE OF WHITE RUST ON *AMARANTHUS POLYGAMUS* LINN.

In spite of the extensive work done on the occurrence of White Rust on Crucifers (2, 3, 4), the disease on any other host has not been seriously studied though there are several reports of work done on the attack of the pathogen on some other host tissue (1). The present note is the outcome of an investigation on the damage caused by White Rust to common vegetables of the plains, other than Crucifers.

Amaranthus polygamus Linn. is a very common vegetable of the plains which occurs as an annual. The occurrence of White Rust on different species of *Amaranthus* was reported by Butler, Dastur and others from different parts of India and Burma.

Symptoms.—The attention of the author was first drawn to the infection when he noted beautiful spots on the leaves of *Amaranthus polygamus* Linn. The appearance of white prominent pustules or more or less blister-like spots on the lower surface of the leaf led to his working out the nature of the pathogen. The pustules vary in size and shape and often become confluent, to form more extensive patches.

The pustules appear in patches strictly on the lower surface of a leaf. When young they look like unbroken blisters, but later burst and the conidia are dispersed. The infection is most vigorous during the month of March and onwards. During this period the temperature is neither uniformly low nor high. The causal fungus gradually disappears with the advent of the summer heat. The attack of the pathogen causes premature wilting of the leaves and hampers further growth of the plant. At first the pustules appear scattered over the leaf surface. With their further development the infected leaves take on a pale tinge and ultimately drop off.

Microscopic Examination.—Sections of the infected leaves reveal the conidiophores associated in groups at right angles to the host tissue and bearing chains of conidia. In some sections the conidiophores are covered by the epidermis, whereas in others where the conidia have matured perfectly the epidermis is ruptured and pushed up like a lid. Through this ruptured epidermis mature conidia are dispersed. The conidiophores are more or less club-shaped and thick-walled. From the apex of these, conidia are cut off in chains in basipetal succession. Conidia are perfectly round when mature; when young the base is more or less flattened and bears a very short stalk-like structure. With gradual maturity the conidium becomes rounded and the stalk disappears. Conidia are hyaline, uninucleate, and measure 18μ to 24μ.

Mycelium is hyaline, non-septate, and shows considerable variation in diameter. Sex organs occur in the same sorus. Both antheridium

and oogonium occur side by side. Immature oospores are present which are more or less globular, dark coloured, rough and warty and resemble resting spores. Mature oospores measure about 54μ.

From the nature of the pustules and dimensions of the conidia and oospores, the causative organism can be identified as *Albugo* sp. (White Rust).

Conclusion.—White Rust (*Albugo* sp.) forms white spots on the lower surface of the leaf of *Amaranthus polygamus* Linn. and ultimately causes damage to the foliage. The infection of the pathogen is strictly influenced by atmospheric temperature. It generally appears during late winter and early summer. The probable source of infection is the oospores, which are plentiful and whose external appearance indicates that they may withstand unfavourable conditions and can pass through a resting stage.

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Botanical Laboratory,
Presidency College,
Calcutta.

ASOK KUMAR KAR*

18.—FREAK SHOTS

There has recently been some correspondence in *The Field* in connection with freak shots, and among the many curious incidents recorded are 14 and 11 teal to one shot in Egypt, as well as 21 snipe with a right and left in England.

It would be interesting to collate some similar shooting stories from India and the ball might be set rolling by quoting Mr. H. B. Hayes who remembers picking up 20 snipe to a right and left of 9s from a 20 bore. This was in Bengal many years ago, early in the season when the birds first arrive in large wisps.

A large wisp doubled on itself just when within range and the 2 shots were fired into the thickest part. The 20 birds were picked

*At present Rice Research Officer, Bankura.

up out of knee-high grass in a hurry, as Mr. Hayes's party was racing another to a snipe ground half a mile away, so it is possible a few may have been left behind.

Will this true story lead to another ?

c/o Faiz & Co. HUMAYUN ABDULALI
75, Abdul Rehman Street
Bombay
30*th July* 1948

APPEAL

INTERNATIONAL DEPOT OF MICROSCOPIC PREPARATIONS OF CYTOLOGY

Created by

THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

An Appeal to Cytologists

In 1939, the International Union of Biological Sciences, requested Professor P. Martens, Director of the J. B. Carnoy Institute, at Louvain, Belgium, to take up again the project of an International Depot of microscopic preparations of cytology, animal and vegetable. This plan had previously been submitted by the Union to the late Prof. V. Gregoire, but owing to his poor health condition he was unable to realize the practical side of this plan. On the other hand, the international situation, and the state of war, have delayed until today the announcement of the creation of this organisation.

It would therefore be a matter of grouping together in an easily accessible center—the Laboratory of Cytology of the Carnoy Institute, at Louvain (Belgium) —preparations obtained from numerous research centers, and having already been used as basis to previously published works. Each worker interested in a definite problem, could thus locate and compare with his own documentation, the original microscopic documentation of other authors relative to the same matter. It is hardly necessary to underline the considerable interest that a depot of this kind would acquire also how much it would favour a good understanding amongst workers, and would smoothen out many difficulties and vain contestations, which are inclined to fill up scientific literature.

But this result can only be obtained with the greatest comprehension and collaboration of the greatest number possible of cytologists. L'U.I. S. B. invites them therefore, from now onwards to send their works to the Laboratory and enclosed with them several preparations having already been used as basis to published works and to review such deposits in the future. It is *desirable* that the spots considered by authors as particularly demonstrative or used as published illustration—should be specially noted on the preparations as clearly as possible. It is also requested that a sample of the published work should be attached when sent.

Every biologist, known for his publications—and any other person, possessing an authorized recommendation—will be able to consult and study as much as they like, all preparations which have been entrusted to the Depot; the consultants will have at their disposition, the Laboratory, the equipment and necessary optical instruments. All work must be done within the Depot, except with a written permission granted by the depositor.

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P. MARTENS
Prof. (Louvain)
Administrator of the Depot

P. VAYSSIERE
Prof. (Paris)
The Secretary General of the U.I.S.B.

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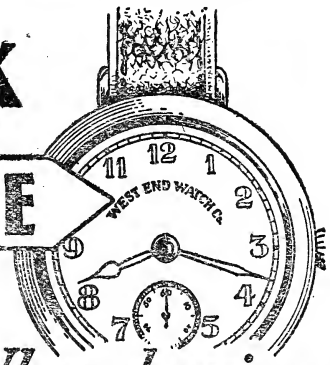

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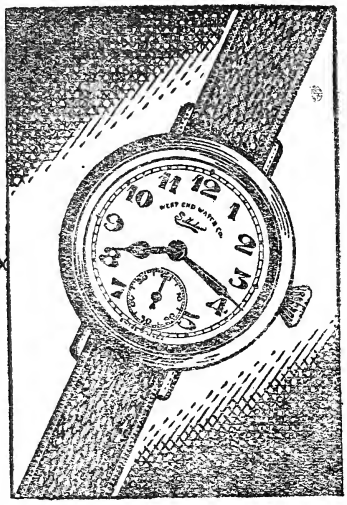

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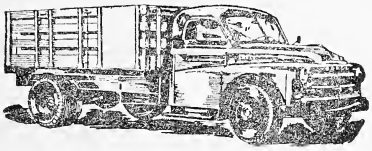

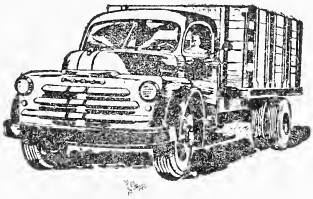

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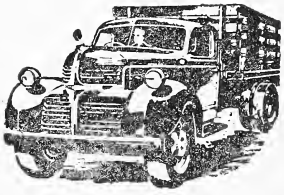

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10TH INTERNATIONAL ORNITHOLOGICAL CONGRESS

The Permanent Committee for International Ornithological Congresses has instructed the Ornithological Society of Sweden to organize the 10th international congress. It is to be held at Uppsala on June 10th-17th, 1950.

According to the preliminary programme the opening of the Congress will take place on Saturday, June 10th, at 2 p.m. Sunday, June 11th, will be devoted to a whole-day excursion; June 12th-17th to congress discussions as well as another whole-day excursion and an afternoon tour. Before and after the Congress, excursions will be arranged to various parts of Sweden.

Ornithologists from all countries are cordially invited to attend. The congress fee is 25 Swedish crowns, and applications should be sent in before the end of February, 1950. Applicants will be furnished with a detailed programme.

At the Congress a few survey lectures will be held by lecturers specially invited. Other members may also lecture or give short announcements.

A preliminary invitation to the Congress will be distributed very soon through representatives in every country, and can also be obtained from the following address: 10th International Ornithological Congress, Uppsala, Sweden.

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JOURNAL
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1949 VOL. 48 No. 2

JUNGLE MEMORIES

BY

LT.-COL. E. G. PHYTHIAN-ADAMS, O.B.E., F.Z.S., I.A. (Retd.)

PART II—ELEPHANTS

(With two plates)

So far back as the days of Asoka Maurya (273-242 B.C.), the killing of an elephant was punished by death, and even now the shooting of one without a permit may involve a fine of Rs. 500. But it would be a great mistake to imagine that elephants have always been protected. Prior to 1873 when the Madras Elephant Preservation Act became law, these grand but destructive animals were classed as vermin, and a Government reward of Rs. 50 was paid on each one brought to bag, without distinction of sex or age.

In spite of the very inadequate weapons of those days, so many were killed that Government became apprehensive lest the supply of elephants for commissariat and forest work might be seriously affected, and consequently passed the Act in question, under which it became an offence to shoot any elephant without special permission. Admittedly shooting in self-defence is allowed, but such a plea is bound to meet with scepticism, and even if substantiated will almost certainly involve the loss of the tusks, while the sportsman will be lucky to escape without a heavy fine. So, for all practical purposes, no elephant may now be shot unless he is a proscribed rogue, and even then permission to retain the tusks is by no means certain.

Meanwhile, thanks to the protection afforded, elephants have increased to such an extent that they have become a serious menace to the cultivator, and some relaxation of the Act is absolutely necessary in the general interest. This was recognised in Burma

so far back as 1910, when it was possible for a bona-fide sportsman to obtain a permit to shoot one or more tuskers, even though not proscribed, and to retain the tusks of any he might bag. Similar action in India is long overdue, and if introduced would go far to protect life and property from these grand but mischievous brutes. It is no exaggeration to say that every solitary tusker is a potential rogue, but under the rules in force he may not be shot until he has maimed or killed some unfortunate villager, and not even then until a Forest subordinate at great personal risk has examined the animal at close quarters and reported on his height, the shape and size of his tusks, and any other distinguishing marks, so that the notice of proscription with necessary details may appear in the District Gazette. All this takes time and meanwhile the probability is that the rogue will have caused more loss of life. Other sportsmen besides myself will have personal experience of such cases, and it is utterly unreasonable that such state of affairs should be allowed to exist, when it can so easily be remedied by the issue of permits similar to those which were in vogue in Burma before the last war. However, these musings—justified as they may be—are hardly 'Jungle Memories', so let us leave the realm of fancy for that of fact, and see whether we cannot at least learn something from the episodes related below.

North Canara

The first time that I encountered elephants in the jungle was in North Canara in 1909, while I was in camp at Dandeli, trying for bison or anything else which might turn up. On 8th May I was working through the jungle with my shikari Raya Gowda towards Pardhana, where I proposed to halt for a week or more, and about 8-30 a.m. heard elephants trumpeting. There had been a lot of rain and as we were moving silently towards them, I saw a yellow animal dash away through the clumps of bamboos about 40 yards off—possibly it was a tiger with designs on an elephant calf, but the thick carpet of leaves left no pugs marks. I went on and found a number of cows but no tusker, so withdrew and worked further round, nearly running on top of a big cow. I saw her before my shikari did, looming above the bamboos about 50 yards away—she looked like a huge wet grey rock in the rain, and at first I was uncertain what it was. But as we got closer my shikari spotted her and hurried me back behind a big tree, when with my glasses I could see a calf lying down close by. We withdrew quietly and further on came across a youngster blowing sand over his back—he spotted us and bolted with a great crashing of bamboos, and the rest followed him. This herd, which had only recently entered the district, was later proscribed on account of the damage they did, but at the time I had no permit, and examined them simply out of curiosity. The lesson I learnt was that with slow and silent progress and with due regard to the wind, it is possible to work up close to individual animals, and in and out of a herd, without being detected.

The Magyigon Rogues

In 1913 while stationed with my regiment at Rangoon, I obtained 60 days privilege leave, and after a 3 weeks shoot at Paungde in the Prome District, in the course of which I bagged some good heads of thamin (including a magnificent one of the rare spatulated type with 14 points), I decided to try the Arakan Yomas for rhino. I reached Thayetmyo on 3rd June and started my march towards Mindon, but at my second halt met the D.S.P., who incidentally at first mistook me for a notorious character known as the 'White dacoit'! He advised me to give up all idea of working the Arakan Yomas in the monsoon but to try the Pegu Yomas on the east of the Irrawaddy where there were excellent chances of elephant, bison and tsine. I already had a permit for one elephant, and when I passed through Thayetmyo on my way back the Deputy Commissioner asked me if possible to deal with three rogues, which were giving a lot of trouble at a place called Magyigon. He strongly advised me to use only solid bullets, as another sportsman had recently fired no less than 28 softnosed at an elephant without success, though it was eventually recovered. Four marches brought me to the village in spite of delays occasioned by floods and a broken axle of one of the carts, and the rest of the day was spent in settling in at the very comfortable forest bungalow and discussing shikar prospects with the local moksos (shikaris). They told me that there were 3 rogues in the vicinity, of which the most notorious was named 'Bedin'. Only a short time before he had played havoc in the village gardens and had even tried to push over one of the great teak posts which supported the Rest House. The second rogue was said to have short but thick tusks, while the third was a 'hine', or tuskless male.

Next morning I started off at 5-30 a.m. and an hour later found fresh tracks of elephant—at first only the indentation of one toe-nail, which I should not have recognised without the tracker's assurance. He was positive from its depth that the animal was a tusker, and shortly afterwards, when complete footprints were visible, identified them as belonging to 'Bedin'. At 7-30 a.m. I saw a very fine tusker standing in rather open bamboo jungle flapping his ears but otherwise motionless—I think now that he probably suspected our approach. There were no big trees under cover of which I could work up, but I managed to reach an ant-heap in the open about 50 yards from him without being detected. I knew that one should get as close as possible before firing, but further approach seemed impossible, so I rested my .400 H.V. Jeffery on the ant-heap and fired a solid bullet at his ear hole. At that range I could not distinguish the exact spot as the ear was flapping to and fro and the bullet failed to reach the brain. He swung round with a roar and came straight towards me for 20 yards while I tried to make myself as small as possible behind the ant-heap—then went downhill on my right like a runaway locomotive. I got in two more shots with the .400 and two from the 10 bore (which my orderly ran up and handed to me) firing for the

spine, as he went up the opposite side of the 'choung', but though badly hit he carried on. I followed as fast as possible but he soon outdistanced us, and we had to slow down when the track shortly after entered some very thick cover. After following the trail through two patches of 10 feet high 'kine' grass where visibility was limited to about 6 feet, I refused to enter any more such but skirted them and picked up the tracks again on the far side. In one place the trail led up a watercourse with precipitous banks about 10 feet high, ending in an almost perpendicular sheet of rock up which I could not have believed that any elephant could climb, but he had, and at the top had swung round and waited some time on the top of the bank. Fortunately he had gone on again before we arrived or he would have had us at a serious disadvantage. At 11-30 a.m. I sighted him moving slowly ahead of us, and hurrying forward caught a glimpse of his tusks in a thicket 40 yards off where he had halted. I could not get a shot at his head which was covered by a mass of dead stuff and I did not then appreciate the value of a body shot. But when he moved on about 5 minutes later, I ran up alongside and fired up at his ear-hole, with as little result as my first shot had, and with a bellow he made off again. We followed till 1-30 p.m. and then on the advice of the trackers, gave it up and returned to the bungalow.

My trackers were not happy about the killing power of the .400 and implored me to rely in future on my double 10 bore. I knew of course that there was nothing wrong with the rifle and that only my bad shooting was to blame, but to humour them I took my 10 bore and a .303 carbine as second weapon when we started out next morning. By 7-15 a.m. we had picked up the overnight tracks and at the request of the trackers we halted to do puja to the jungle *Nats*. The rifles and dahs were placed on a cloth under a tree, with incense, cheroots, etc., and prayers were offered for our success. On previous occasions a similar ceremony had produced a quick result, but on this day its action was delayed. We followed the trail steadily hour after hour but could not come up with the rogue, though we found the place where he had slept. At last at 1-30 p.m. I heard bamboos being broken ahead of us, and saw there were now tracks of two elephants—I thought one of them was my wounded animal but later found that he had branched off. Moving towards the sound I saw two elephants feeding—one of them a small tusker, but the other a good deal larger with short though thick tusks, and the trackers told me that he was one of the rogues. They also intimated that now they had brought me within sight, the rest of the operation devolved on me, and without making any bones about it climbed up trees to await the result. The jungle was very open but I managed to work up to a small clump of bamboos 20 yards from the rogue. Here I left my orderly with my spare rifle and being determined to make no mistake about it this time, walked out across the open until I was within 10 yards of his backside (which seemed close enough to slap !), and then as his head swung round fired a conical bullet from my 10 bore at the earhole. He dropped to the shot and never moved again, but as the small tusker

came up to investigate and seemed inclined to give trouble, we withdrew about 100 yards. A shot in the air drove the survivor off and the trackers now came down from their trees but would not approach the fallen tusker till I had fired a shot with my .303 into his body, which I remember quaked like a jelly. He was 9′ 3″ at the shoulder with a good average pair of tusks but nothing like Bedin's—there were a number of dead horse-flies stuck to the skin of his back, evidently squashed by the branch I saw him plying when we first sighted him. We had scarcely finished taking measurements when some 40 Burmans—men, women, and children—turned up. They had followed us all day, at a discreet distance, for the sake of the meat, as they were confident that I would bag an elephant, and had closed up on hearing the shots. They got busy at once, some building small huts of split bamboos to smoke the meat in, and baskets of the same material to carry it back, while others started to cut up the carcass. The Burman is an artist with his dah, and it was most interesting to watch their use of it. But time was passing and we had to get back to camp which I now learnt was 4 hours away. It was not till then that I realised how tired I was—we had been on the go for 2 days and had covered an immense distance over very bad country, through heavy jungle with tangled undergrowth and fallen trees, through swamps and thorny cane brakes, uphill and down, and much of the time in pouring rain—added to which was the mental strain of following a wounded animal for so many hours. By the time we reached the bungalow at 7 p.m. we were about all in, trackers and orderly included, and personally I have never felt so tired before or since—Was it worth it? Of course it was—every time!

For the next 2 days I could get nothing done about Bedin as the whole village had gone out to the dead elephant and were gorging themselves on the meat and smoking what they could not eat, but as soon as that was over I renewed the search for the wounded animal. I sent trackers out to distant jungles and for the next week was out all day looking for tracks, but apparently he had cleared right off and we never saw him again, nor did I hear his fate till 7 years later. It was in 1920 that while travelling down to Rangoon in the night Mail, I got into conversation with another passenger and learnt that he had come across Bedin by chance some time after I had left Magyigon and bagged him. He told me that though very emaciated, the rogue appeared to have recovered from his wounds. I forgot the weight of the tusks, but they were a very fine pair, much above the average.

The mistake I made over this elephant was taking the head shot in the first place instead of firing at the heart. I had at the time no practical experience of elephant shooting, but had studied the diagrams in Sanderson's book, and had come to the conclusion that the head shot was *the* shot to take. So it is if you are close enough, but you have got to be very close indeed to make out the ear-hole, and at 50 yards it would have been a fluke if I had found the brain. Far better would it have been if I had fired at the heart in the first place and also during the follow-up when I had a clear

view of his side but could not make out his head. Later on I heard of a sportsman who had been very successful with elephants, and his method was to fire both barrels of his H.V. rifle at the heart and then return to camp—the elephant was almost invariably found dead next day within half a mile.

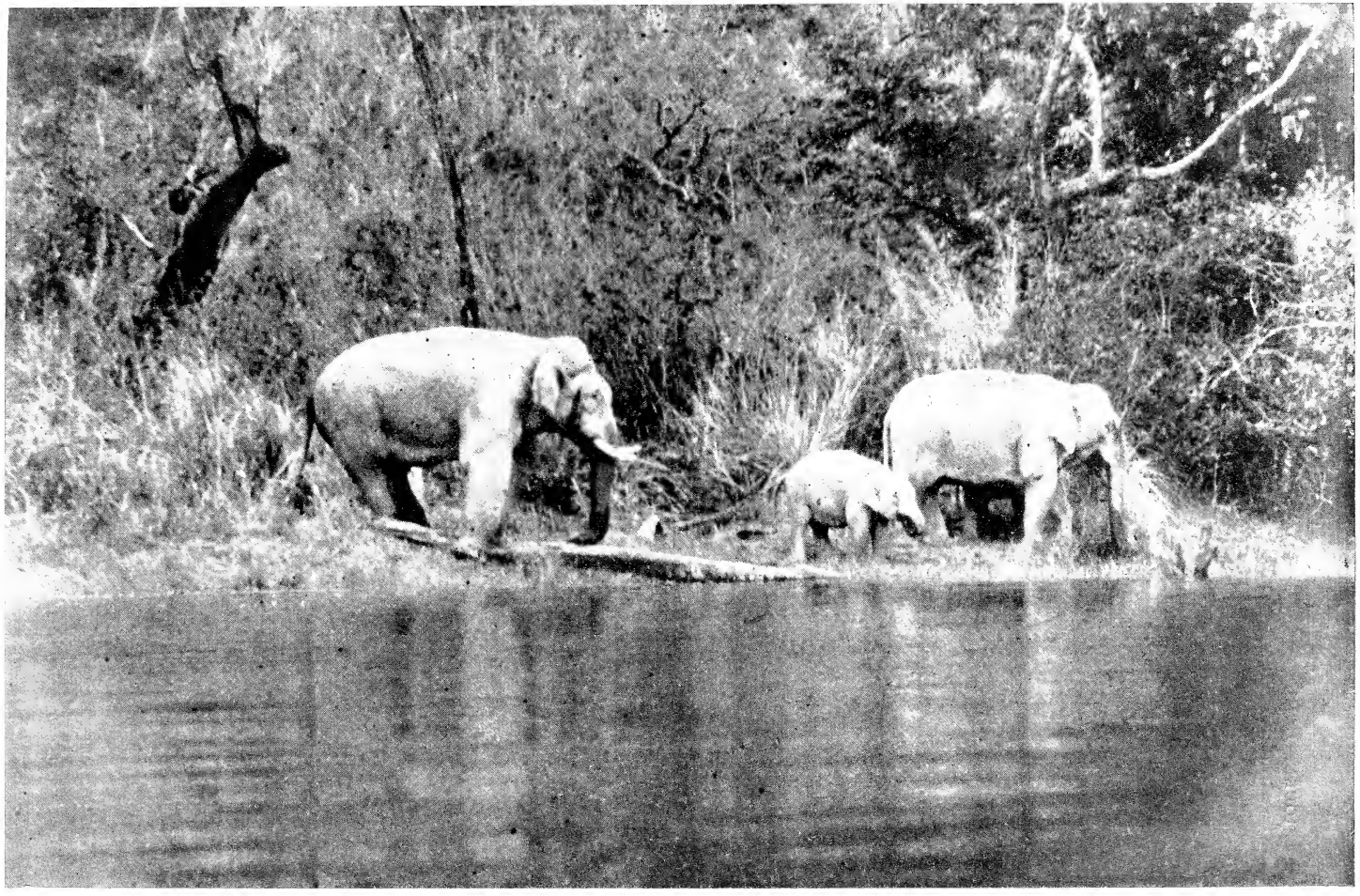
So much has been written about headshots, that many sportsmen have come to believe it is the only way in which an elephant can be shot, but this idea, which probably dates back to the old days of black powder rifles, is a mistaken one. A heart shot is not to be despised—if well placed it is equally fatal, although the effect may not be so immediate. Major Evans in *Big Game shooting in Upper Burma* puts it very aptly when he says that the head shot is the poetry and the body shot the prose of elephant shooting.

The Taiping Tusker

How difficult it is to get a shot at an elephant from the back of another is well illustrated by an experience I had while shooting near the Taiping river north of Bhamo in 1914. In the lines at the Fort were 9 Commissariat elephants which had once belonged to King Thibaw and had been captured during the 3rd Burma War. We were allowed to hire these for shikar, when not otherwise required, for the ridiculously small sum of Re. 1 each per diem. In June I engaged two and marched to Teinthaw on the Mole Chaung, when I heard there was a good solitary bull bison. On the 3rd morning I was out on 'Luxmee' to try and bag a hog-deer for the pot, and while working a swampy plain of 10 feet high grass heard an elephant trumpet—we could just see his back above the grass about 100 yards away. I had a permit for two elephants, so moved up to view his tusks, and got within 30 yards but could not make them out clearly. He went off and kept moving in a circle of about 400 yards diameter but would not leave the grass, so from my elephant I climbed a tree and then had a good view of him as he came straight towards us (probably attracted by my mount) and halted 40 yards away. I could see that his tusks were smaller than the ones I had obtained the previous year, but even had I wished to fire it would have been impossible to get in a fatal shot, as his body was hidden by the grass and a frontal shot at his head from above was out of the question—so we left him to it and came away. Later I heard that he was a rogue and had killed 3 men, but he certainly showed no signs of ill feeling towards us. He had once belonged to the Wunthoo Sawbwa, so my mahout told me, and had been turned loose when that chief fled to China in 1891 after his abortive rebellion.

The Yinmabin Rogue

The year 1920 found me at Meiktila in Upper Burma in command of the 2/80th C.I. I had my hands pretty full with the command of the station in addition, and the custody of 5,000 unfortunate Turkish prisoners still awaiting repatriation, but found time for an occasional week-end run up the Kalaw Ghat to Yinma-

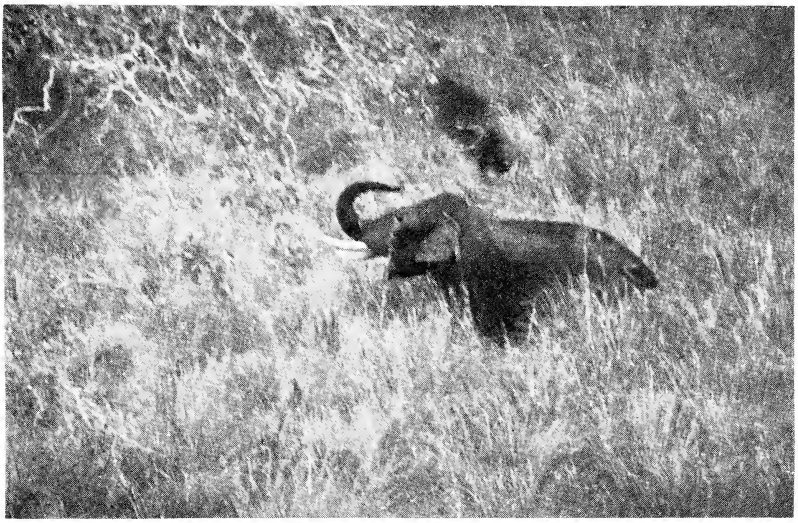


Sálim Ali

Tusker and Family
(*Periyar Wild Life Sanctuary*)

Photo by *Author*

The Cradle Tusker



Copyright *Sálim Ali*

A Tusker scents danger

bin, which was an excellent shooting centre. On my first visit there I was told of a rogue which only the week before had killed an old woman gathering sticks in the forest, and according to my mokso, had torn her arms and legs off. I applied for and was granted a permit to shoot this animal, but my opportunities were limited and it was some months before I came across him. As is usually the case he was a solitary but at times joined a herd, from which he had no difficulty in driving away the hine (tuskless male) normally in charge. Each time I met the herd it was therefore necessary to comb it out, and very exciting work it was dodging from tree to tree, and of course all the time keeping the wind, but it was not till 10th November that I found the rogue with them. We first met the hine by himself half a mile before we came up with the herd so guessed our luck was in. There were about 20 of them spread out more or less in a semi-circle, and by working from tree to tree I managed to get into the middle undetected and within 35 yards of the rogue. He was partly covered by two big cows and I had to wait some minutes before they cleared him—luckily no puff of wind gave me away as there were elephants on three sides of me. It was too far for a certain head shot, so as soon as I got the chance I fired a solid bullet from my .405 Winchester at his shoulder. He rushed away followed by most of the herd, but a young tusker halted on the other side of the tree behind which I was sheltering, with his trunk up trying the wind. I fired a shot in the air and he bolted, and I then heard an extraordinary wheezing noise in the direction the rogue had taken, rather like a platoon doing deep-breathing exercises. I ran forward and found him on the ground trying to rise. Here was a problem of which shikar books take no account—how to finish off an elephant lying down. I went up within a few yards and kneeling down to get the correct angle fired at his heart, but his struggles continued. So I ran round behind him and put a bullet into the base of the skull and that settled the matter, and incidentally taught me a very useful shot. My first bullet had gone too high and smashed his shoulder, and once he was down he could not get up again. I think his lungs must have been pierced too—an elephant's heart is rather low down and I did not allow for this.

The Cradle Tusker

It was in December 1931 while I was living in Mysore City that I first heard of this rogue. He was in the habit of visiting the fields near Areipalaiyam village in North Coimbatore at certain seasons, but most of his time was spent in Mysore territory where he could not be pursued. He had been proscribed in Coimbatore for a good many years and was credited with the deaths of 8 villagers—had been fired at on several occasions but escaped serious injury—and finally derived his name from his curved tusks which were reported to be a magnificent pair. Such was the description of this notorious rogue, and he seemed to me an animal very well worth trying for.

I camped at Areipalaiyam in January 1932 to study the ground and to obtain first hand local information, and soon realised that it was going to be a big job, as the rogue's visits were so uncertain and of such short duration. Further trips in May and July also drew blank and it was obvious that without timely information of his movements I should have little chance of intercepting him. My good friend M. who owns an estate not far away, very kindly lent me the services of two of his trackers, and promised to let me know when the rogue next crossed the Coimbatore boundary. The expected wire arrived on 1st November and dusk of the following day found me installed in the Areipalaiyam forest bungalow with the comforting news that the Cradle Tusker was in the vicinity and that at last I should be able to try conclusions with him. Soon after dawn on the following day I went down to the Sholaga village and picked up the trackers and we started up the path which runs over the ridge to the Gundal Rest House. At the col I saw for the first time the footprints of the rogue, which were simply immense when compared with those of the other two elephants which accompanied him—a tree against which he had rubbed himself also gave me some idea of his great height. The tracks led down to the Gundal Valley, so we followed, but after ravaging some fields the elephants had, so we learnt, been driven off by fire and had retired up the Hethinibetta hill. A terrible climb of 1,500 feet followed the path being simply a rocky track practically straight up through a tunnel of bamboos without a breath of wind. I have seldom sweated so much, and felt it all the more as I was soft after 5 months enforced rest due to an injured knee. About 1 p.m. we topped the col where a spur runs from the main hill to join up Kortaybetta, and at once I distinctly smelt elephant, and also heard movement in the bamboo covered ravine below us. Working along the hillside we found a convenient rock and sat down to have an easy and await events. Half an hour later a small tusker appeared and cleared off in a hurry for no obvious reason, but we could still hear at least one elephant feeding about 150 yards below us. The trackers now went off to see whether an approach was possible and shortly before 2 p.m. one of them hurried back and beckoned to me urgently. I went down and saw indistinctly through the bamboos about 80 yards away the head and tusks of a big elephant which the trackers assured me was the Cradle Tusker. Leaving the men behind I advanced with my driver George carrying my spare rifle to a tree about 30 yards from him, and as the elephant moved forward to our right I had a clear view of his head and tusks. The latter however were not so long as I had been led to expect, and to make absolutely sure that there was no mistake, I beckoned one of the trackers down and questioned him. He assured me that it was the Cradle Tusker—he had known the animal for years and was quite positive about it. Being satisfied, as soon as he stopped moving and I had a clear view of the earhole, I fired at it, but did not allow for being on slightly higher ground, so that my bullet—a solid .423—as we afterwards found, passed below the brain and was embedded in the base of the tusk on the

far side. At the shot he swung round and rushed back a few yards, then towards us, but as we remained motionless he was uncertain where the shot had come from, besides doubtless being a little dazed. He then turned away and up went his trunk in the air trying to get our wind. I aimed behind his ear but as he moved still further round and exposed the base of his skull, got the bead on to that and fired. At the shot he reared up and fell over backwards with a most almighty crash against a clump of bamboos which gave way under him with much splintering and cracking, and I was on the point of running up to give him another bullet if necessary when a third elephant, which we had not previously seen, made his appearance and came hurrying towards us. He was quite a good sized beast with tusks about 3 feet long, but compared with the Cradle Tusker looked an infant. I don't think he saw us, but as he was getting rather too close and I had no permit to shoot him, we withdrew to our rock and shouted at him when he cleared off and allowed us to examine our prize.

In that classic *Thirteen Years among the Wild Beasts of India*, Sanderson expresses the view that, 'there is little doubt that there is not an elephant 10 feet at the shoulder in India'. I only wish he could have been present to check up on the Cradle Tusker! Careful measurements between uprights at heel and shoulder gave him a height of 10′ 6″, and this was confirmed by the foot measurements, allowance being made for loss of expansion since the animal was in a horizontal position. The size of the tusks had been greatly exaggerated, but even so they were a fine pair taping 5′ 7″ and 5′ $6\frac{1}{2}$″ respectively with a girth of 16″, while their combined weight was 97 lbs. according to the Forest Dept. scales. In accordance with the rules they had to be surrendered, but were eventually returned to me by order of the Board of Revenue, after I had signed a declaration that I had shot the rogue 'at close range and at great personal risk'!

On the following morning, when we returned to extract the tusks and remove the feet, we found the third tusker still in the vicinity, but 'Little Boy' soon chased him away. He had visited his dead companion during the night but had made no effort to move him, as elephants sometimes do. When skinning the rogue we found 2 bullets just under the skin of his side and fore-leg, and another was deeply embedded in the forehead—no doubt there were others which we overlooked, as in the course of his career he had been fired at often.

Now to analyse the shots taken, and to see what can be learned from them. I think there can be no doubt that with such a bloody-minded animal it was imperative to take the head shot, and this seemed to offer no difficulty. I was reasonably close, had the side of the tree to steady my rifle and thought I had him cold, and yet I missed the brain, because I did not allow for the fact that we were not on the same level. An elephant's brain is small compared with the huge bulk of his head, and the side shot is definitely difficult, as it is not easy to make out the ear-hole among the wrinkles of the ear. The frontal shot is much easier, in fact I was told on

the best authority of a thugyee (village headman) in the Thayetmyo district of Burma who with a single barrel 12 bore and the ball cartridges supplied by Government as a protection against dacoits, accounted for a number of cow elephants in this way! For the second shot I had to thank my experience with the Magyigon rogue as already related—it is a shot well worth knowing.

The Benne Rogue

It is over 10 years since I shot my last elephant, but the encounter was an exciting one, and the memory of it is still so fresh that a reference to my diary serves only to confirm it. On 26th April 1937 a Forest Guard accompanied by another man was walking along the road between Masnigudi and the foot of the Sigur Ghat in the Nilgiris when an elephant, previously proscribed, suddenly rushed out of the jungle at them and killed the guard, who had stumbled in his efforts to escape. My house is at the top of the Sigur Ghat and only some 9 miles from the scene of the tragedy, but I did not receive news of it till two young officers who had gone after the animal, looked in on their way back and gave me an account of what had occurred. It had taken them 2 days to locate the brute and when they did come up with it they had fired a number of shots into its head and body, but owing to lack of experience none of these was fatal, though one shot actually floored it. That night the rogue moved along the foot of the hills and was located on 2nd May in some very thick cover near Anaikatti, where they had to leave it.

As it happened I had already booked the forest bungalow at Anaikatti from the 4th, so when we arrived I at once sent men to track down the wounded animal, since both R. and I possessed permits to shoot it. The trackers returned in the evening with the news that they had located the rogue with another elephant at Sirur some 6 miles to the east, and that he was in a bad way and constantly lying down. Next morning on arrival at Sirur we took up the tracks and soon found several places where the animal had lain down, but there was no blood, which rather surprised me in view of the number of wounds he had received. Soon after we heard bamboos breaking and the tusker's head and back appeared above the lantana about 50 yards below us. He was uneasy but not alarmed, and after 5 minutes moved slowly uphill—we followed along the hillside above him and as he came out of the bushes into the open had a grand view of him not 30 yards from the rock on which we were sitting. Before firing it was however essential to make sure that it was the rogue, and as I could see no sign of wounds (he was well plastered with mud) we went back to the river and measured his footprints which definitely showed that he was not the proscribed animal, though his lying down so frequently rather indicated that he was sick. So we left him to it and were sitting on a knoll having an easy before taking up the tracks of the second animal, when the latter appeared crossing the open about 1,000 yards away. He was a magnificent beast with tusks show-

ing at least 5 feet of ivory and so curved that they reminded one of a mammoth's. They alone were sufficient to show that he was not the rogue, whose tusks were known to be short and straight, and as no other tracks could be found, we had to give it up and return to Anaikatti. We remained in camp there till the 9th, but though I had trackers out daily, no further sign of the wounded animal could be found, and it was not till several days later that I had news of him. Where he had been in the meantime is unknown, but on the night of the 14th he came on to the main road beyond Masnigudi and walked along it to Teppakadu, where the villagers heard him wheezing—no doubt from a lung wound—as he crossed the bridge over the Moyar river close to their houses. His tracks then led towards Mudumalai, so R. and I motored down there on the 16th only to learn that the rogue had moved on towards Benne. Next morning he was definitely located near the elephant camp 8 miles away, so we at once motored there, arriving about midday and bagging en route a wild dog which I hoped would prove a lucky omen. The rogue was said to be at the foot of some low hills 2 miles off, so we set out, meeting on the way one of the trackers who had located the elephant and had identified it by the wound in its side. A climb through long grass up a spur brought us well above him, and after a short halt we then began the final approach down to the small stream where the rogue had last been seen. The jungle was thick and there was a nasty tangle of bamboos, while big trees, which are such a comfort when working up to an elephant, were few and far between. After about 200 yards we found a place where he had just fed on bamboos, and then suddenly saw him only some 30 yards away standing in the bed of the small stream with his head towards the steep bank on our right. After a whispered consultation we decided to move up the bank to the left so as to be above him, which was done, and R. and I then advanced down the open slope to a tree which I had marked down not 20 yards away from the rogue, where our feet were about the same level as his back and with the ground sloping gently towards him. He was tail on to us, idly swinging a hind leg and his tail and occasionally flapping his ears. There was no wheezing noise from the lung as reported, and since from our position we could see no wounds, I beckoned up Mada and the mahout, whom we had left behind, to make certain that he was the right animal. They insisted that it was, so I got ready to shoot, as the wind was uncertain and might change at any moment. We had arranged overnight that I was to fire first at the head and R. to fire at once after at the body. We had not anticipated an end-on shot but there was no time to make other arrangements. Accordingly I fired at the back of his head, though I doubted whether a shot at that angle would prove effective, while R. fired at once after at his spine. The huge brute seemed to crumple, but suddenly whirled round with coiled trunk and in grim silence came straight for us. We both fired again and down he crashed dead only 15 yards away with 2 bullets in the brain. We counted no less than 9 old bullet holes, one severe 5 inches in diameter behind the right shoulder

(too high for the heart) from which pus was dripping and what looked like a piece of lung—we could not examine this properly as he had fallen on that side. There were 2 wounds on the bump at 3 and 6 o'clock—a big wound on the left side of the forehead and 5 more scattered about the upper part of the head. In all 14 shots had been fired into him during the encounter on 1st May and in spite of this he had covered not less than 50 miles and probably twice that distance, and had survived for 17 days, so I don't think there can be much doubt that if we had not encountered him he would eventually have recovered. All of which goes to show that an elephant is not an easy animal to kill unless hit in the right place. Measurement showed the rogue's height to be 9′ 4″ and the tusks when extracted taped 54″ and weighed 48 lbs. The rifles used on this occasion were both H.V. with solid bullets—mine a .423 Mauser and R's a double .470, and the 4 shots must have been fired in the space of 5 seconds.

This brings to an end my experiences of shooting elephants, which, limited though they are, contain some lessons which I hope may be of use to others. To any sportsman about to hunt these animals for the first time, may I offer a few words of advice? First read Sanderson's book and after studying the diagrams of an elephant's head, compare them with a living elephant if possible, or at least with the photographs which so often appear in illustrated papers, paying particular attention to the bump and the ear-hole—you should then have no difficulty in deciding where to aim when you are up against one in the jungle. But remember the head shot is not worth taking unless you are very close indeed, and that to get close you have got to take some risks of detection—do not therefore despise the body shot. When you are going after a rogue try and get another sportsmen to accompany you, and arrange with him beforehand that one should take the head and the other the body-shot—also which of you should fire first. Remember that you are dealing with a bloody-minded animal, who will certainly kill you if he gets a chance—you need therefore feel no compunction about firing to cripple him if you are doubtful whether a fatal shot offers. Once an elephant is down run up and give him a finisher in the base of the skull before he can rise. Do not follow the example of the Burmese thugyee, but use a high velocity rifle of not less than .400 bore with solid bullets. Finally, before you shoot be quite certain that the elephant in front of you is the animal for which you hold a permit. Two elephants had been shot by mistake for the Cradle Tusker before I accounted for him, and both were proscribed posthumously. It is not always that district officers are so complacent!

Rifles

Sportsmen, more especially those new to the game, may be interested to have my experiences with various types of rifle. I came out to India in 1904 very keen but with no experience at all except of small game shooting, and shikar books in those days

were few and mostly out of date, since the high velocity rifle of medium bore had only just appeared on the scene. My first rifle was a .256 Mannlicher but I soon found it too light and changed to a single barrel .400 H.V. Jeffery, a first class weapon which accounted for many head of game in my subaltern days, but had the drawback of being a single loader. To supplement it I picked up a DB .577/500 No. 2 Express by Rigby firing low pressure cordite and a nickel cased bullet of 440 grs. with a copper tube, or 460 grs. solid lead, a most excellent rifle for tiger, but not heavy enough for bison and elephant. For those I purchased a DB 10 bore ball and shot gun by Jeffery, which weighed 16 lbs. and fired a 2 oz. ball, but used it little as the 1st World War intervened. A .303 magazine carbine which I obtained from the Ordnance and refitted with a bead foresight proved very useful for lighter game, and also as a spare weapon, but it was not easy to obtain sporting ammunition for it, and experiments with filed down solid bullets were not very satisfactory. I also for a short time possessed a .280 Ross, but did not care for the action and soon disposed of it. For a good many years I used a .405 Winchester, but finally changed to a .423 Mauser—a rifle which I still use and can strongly recommend to the sportsman with a shallow purse. With it I have shot most kinds of South Indian game from jungle sheep to elephant, and have seldom found a second shot necessary. To supplement it I have a .318 Mauser with telescopic sight, more particularly for crocodile shooting where extreme accuracy is essential. I do not believe in small bore rifles for dangerous game. Let the sportsman use the heaviest rifle he can and he will be saved a lot of trouble. Personally I prefer a magazine rifle to a double barrel.

NOTE :—

The stories of the Cradle Tusker and the Benne rogue have already appeared in somewhat similar form in the *Times of India* Xmas supplement for 1937 and the *Indian State Railway Magazine* respectively, and are reproduced by kind permission of my collaborator Major F. Murcutt and the editors of the journals concerned.

(*To be continued*)

NOTES ON THE NESTING HABITS OF SEVEN REPRESENTATIVE TROPICAL SEA BIRDS

BY

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(*Raffles Museum, Singapore*)

(*With five plates*)

CONTENTS

INTRODUCTION

The data on which this paper is based were obtained during a residence of $2\frac{1}{4}$ years on Christmas Island (September 1938-December 1940) and $10\frac{1}{2}$ months on the Cocos-Keeling Islands (December 1940-November 1941). Both islands lie in the eastern portion of the Indian Ocean, approximately between the latitudes 10° and 12° south.

Christmas Island is almost due south of Java Head. It has an area of about 64 square miles, with a maximum length from east to west of 13 miles, and from north to south of $11\frac{1}{2}$ miles. It is composed of a covering of coral limestone on a core of basalt. The greater part is occupied by a central plateau, 600 to 700 feet above sea level, rising in three places to low hills with maximum altitudes ranging from 970 to 1,170 feet. Round the edge it descends to the sea in a succession of terraces, separated by steep slopes or sheer cliffs. The lowest of these terraces, known as the shore terrace, runs almost completely round the island, at a height of 30 to 50 feet above the water. The Cocos-Keeling Islands are typical coral islands, similar in most respects to the majority of those in the Maldive and Laccadive groups. They comprise a medium-sized atoll, and a small atollon, known as North Keeling, some fifteen miles further north (see Gibson-Hill, 1948).

These notes cover only seven of the sea and shore birds breeding on one or both of the islands. They have been selected for presentation here as representative of their genera as they occur

in the Indian Ocean, and as the ones for which the greatest amount of data was obtained. References are made to the others where the differences seem likely to be of interest.

The majority of the tropical sea birds breed on small, often isolated and relatively inaccessible, islands. There are, therefore, few ornithologists who have had an opportunity of watching them over a long period. Much information has been published on nest sites and structure, and to a lesser extent egg sizes and colours, in different parts of the world, but little or nothing on incubation periods, rates of development and feeding. Two summaries of the data available at the times when they were compiled have already appeared (Bent 1921 and 1922, and Murphy 1936). These and several subsequent papers, particularly those relating to the islands of the Indian Ocean, have been examined, and reference is made to them where they give information on the latter points. On the other hand, to keep this paper as short as possible, no comments are made on observations in the first category, except in cases where it would appear that the birds under observation were not behaving typically. The one exception to this is that I have in parts used data published in a previous paper of my own (Gibson-Hill, 1947b), based on the observations made in my first fifteen months on Christmas Island. This has been done where no further information was discovered in the subsequent two years' work, in order to make these biographies, though concise, as complete as possible.

Anous stolidus pileatus (Scop.) *Common Noddy*

The Common Noddy occurs on both Christmas Island and the Cocos-Keeling Islands. In both places a few birds are present throughout the year, but the great majority arrive a little before the beginning of the breeding season and leave shortly after its close. In both, also, the birds are conspicuously confined to the coast or lagoon beaches, and they never appear to venture far over the land. The breeding population on Christmas Island in 1940 was in the region of 4,000 to 5,500 pairs. In the Cocos-Keeling Islands in 1941 there were about 20 pairs nesting on the main atoll, and 500 to 750 pairs on North Keeling.

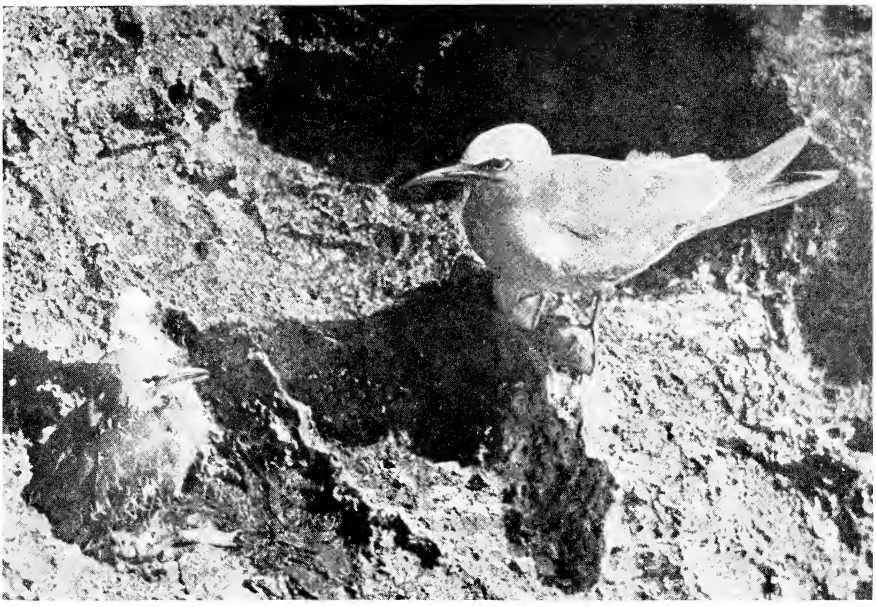
Situation.—On Christmas Island nests were found only on ledges on the sea cliff, usually within 15 to 30 feet of the water, except for one which was in the crown of a small *Pandanus* palm projecting over a narrow beach on the north coast. The birds on North Keeling were breeding on the summit of a low shingle ridge, between the beach and the beginning of the vegetation, at the south-east, windward corner of the island. The 20 odd pairs on the main atoll were nesting in the crowns of a small clump of coconut palms on the lagoon side of the south end of West Island. The site chosen appears to vary considerably in this species, and the use of trees and bushes has been recorded from several localities in America and the Pacific. It is therefore surprising that prac-

tically no use was made of the dense vegetation, reaching to the cliff-edge, on Christmas Island.

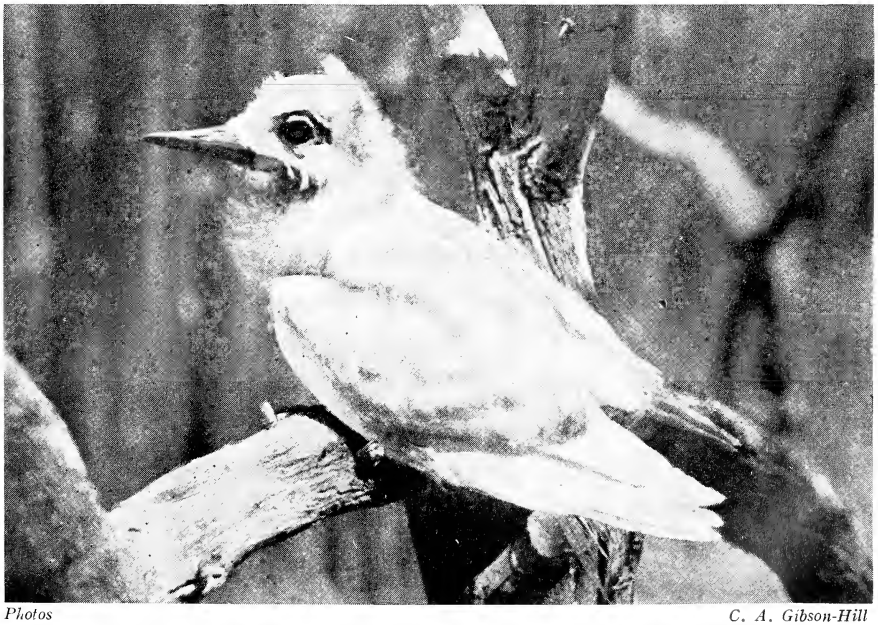
Nest.—No indication was seen of the construction of a proper nest. During courtship, on Christmas Island, the male bird brought his mate occasional offerings of sticks or other flotsam. These she placed on the ledge on which she was standing. Some birds accumulated a considerable amount of material, and by the time that the egg was laid had an untidy layer of debris covering about a square foot of rock. Others gathered only some half dozen pieces. The fragments were not worked together and individual pieces occasionally fell off the ledge. Generally a few bits were added during incubation, but they did not in the long run compensate for the loss, and by the time that the chick was ready to fly the shelf was usually bare. On North Keeling the Noddies were placing their single eggs in suitable depressions among the coral shingle, or among the coarse grass immediately behind it. A few pairs had lined the hollow sparsely with dried leaves and twigs of *Tournefortia,* but in most instances it was bare. The birds breeding in the coconut palms had gathered a few leaves and other material, but even here little attempt was made to construct an adequate nest. In general it would appear that on both islands the nest is rudimentary. In this feature the Noddy would seem to vary from place to place in its range, though nowhere does it build well and securely (see Bent, 1921 : 303-306. Murphy, 1936 : 1154. Van Bemmel and Hoogerwerf, 1940 : 461. Vesey-Fitzgerald, 1941 : 528).

Eggs.—All the nests examined contained only one egg, or a single chick. The egg is roughly ovoid, slightly more pointed at one end, with a fine matt surface. The ground colour ranges from a warm off-white to very pale fawn, with a few light gull-grey or pale purplish grey blotches, and above them a few fine or coarse, umber or dark umber, markings mostly at the wider end. Thirty examples from Christmas Island ranged from 51 to 56 mm. in length and 35 to 38 mm. in breadth: average, 53.3 × 36.1. Ten measured on North Keeling ranged from 50 to 54 mm. in length and 34 to 37 mm. in breadth: average, 52.9 × 36.

Breeding Season.—On both islands the Noddy has a definite fairly well marked breeding season, but though their latitudes are almost the same the times are different in the two places. On Christmas Island the season runs from the beginning of April to the end of September. The earliest egg was seen on 24 March, on the east coast, and the latest on 3 September, at the north-east corner of the island. The majority are laid in May, and hatch in June. On North Keeling nests, all containing eggs, were plentiful in January, and in July the only signs of reproductive activity were a few juveniles, with slight fragments of down on the belly and wings, which flew with difficulty. Most of the birds breeding on the main atoll laid in January, and all had finished and left by the end of June. The season in the Cocos-Keeling Islands would therefore appear to be about four months earlier in the year than



Chick of the Common Noddy, aged about 23 days, with adult bird.



Photos *C. A. Gibson-Hill*

Chick of the White Tern, aged about 35 days.

Chick of the Brown Booby, aged about 4 days.

Photos *C. A. Gibson-Hill*

Chick of the Brown Booby, aged about 65 days.

that on Christmas Island. A set breeding period, varying in timing in different parts of the world, would seem to be the normal procedure for this species, though evidence from the Galapagos Islands suggests that the local race there may be nesting regularly throughout the year (Murphy, 1936: 1159-1160). Vesey-Fitzgerald, writing of *A. s. pileatus* in the Seychelles says, 'Eggs are laid throughout the year, but the main laying season is July and August'. (1941: 527).

Incubation.—Both parents incubate. On Christmas Island, where prolonged observation was possible, it appeared that the shifts were normally short. The birds sometimes made as many as five changes in the course of a day. The egg was seldom left unattended for long, though on several occasions the sitting bird was seen to fly down to the water for a few minutes to moisten its feathers. The incubation period was timed in thirteen cases. In eight of these, where the beginning was known to within a few hours, it lasted from 33 to 35 days. In the other five it ranged from 30 to 35 days, but it is possible that the shorter periods were underestimated. Watson, working on the Dry Tortugas, in the Gulf of Mexico, gives 35-36 days (Watson 1908): Murphy says 32-35 days (1936: 1156).

Feeding of the Young.—At first the chick is fed at short intervals, in the region of two to three hours, with liquid material regurgitated for it. Towards the end of the first week it is usually left alone for the greater part of the day, though one or both parents still settle with it at night. Its food, which is brought only about four times a day, is more nearly solid, and later becomes completely so. Feeding continues for some weeks after the birds are capable of flying. At first the young remains near the nesting ledges and return there to be fed. Later it may be seen soliciting its parents at any of their alighting places away from the breeding site.

Fledging.—The young bird emerges covered with down. On Christmas Island this was usually a smoky grey colour, paler over the forehead and belly, but in about one tenth of the chicks it was a uniform dirty white. The down is pre-plumule.

The earliest feathers are a longitudinal plaque down the back and a small patch in each scapular region. These start to sprout through the skin about the seventh day. The remiges, on the radius, appear about the same time, and the rectrices shortly afterwards. Nevertheless, as late as the tenth day the young bird, on superficial examination, still seems to be clothed only in down. By the twelfth day the juvenile feathers appear above the down all over the dorsal surface of the body. By the twentieth to twenty-second day the down is represented only by a few fluffy fragments adhering to the feathers of the belly, wing coverts and gular area. Left to itself the chick begins to fly about the thirty-fifth day.

In 1940 the chicks in ten nests were measured at intervals of two days. Six of the eggs hatched between sunrise and noon, and the other four during the afternoon. No attempt was made to climb down to the nest the first day. Measurements were not

continued beyond the twenty-ninth day, as at this stage the chicks, though still unable to fly, were very willing to precipitate themselves into the sea to escape capture when the ledge was approached. Some of the chicks grew rather more rapidly than the others during the initial stages, while others developed more quickly during the second and third weeks. The figures below, obtained from one nest, are given as the nearest to the average of the series: all measurements are in mms. Unfortunately the early records for the length of the wing are missing from this sequence. The normal length shortly after hatching is about 15 mm., and this has been added in brackets.

Approximate age in days	*Total length*	*Gape*	*Wing flat*	*Longest primary*	*Longest scapular feather*	*Longest rectrices*
1	108	22	(15)	...	...	...
3	130	23·5	?	...	...	...
5	143	25	?	...	...	...
7	158	27	?	...	...	...
9	177	28·5	?	...	8	...
11	196	30·5	?	8	17	6
13	210	33	?	17	24	14
15	220	34	56	26	34	16
17	235	35·5	68	35	40	19
19	247	37	78	39	45	22
21	258	39	89	43	49	25
23	263	41	100	50	49	30
25	267	42	117	60	50	34
27	280	43	134	61	50	43
29	307	46	148	65	50	48

Gygis alba monte Math. *White Tern*

This bird does not occur on Christmas Island. On the Cocos-Keeling Islands it is resident throughout the year on both the main atoll and North Keeling. The birds may be met with in the open sea a few miles away from the group, but they are never seen at any great distance from the land. On the main atoll the birds were nesting mostly on Horsburgh Island (Pulo Luar), but there were also two or three pairs on the west end of Direction Island (Pulo Tikus). An accurate estimate of the total population was not possible, but it was probably between 100 and 300 pairs. There was also about the same number of birds present on North Keeling.

Situation.—The single egg is usually deposited on the branch of a tree, or against the midrib on the horizontal portion of the curving frond of a coconut palm. The trees generally chosen are the Cocos Ironwood, *Cordia subcordata* Lam., or Kayu Sireh, *Tournefortia argentea* Linn. The sites most favoured were between ten and twenty-five feet from the ground, and a short distance in from the edge of the island.

The choice of nesting site would seem to be a fairly normal one for the species. In the use of tree branches it is noticeably similar to that recorded for the Seychelles by Vesey-Fitzgerald (1941: 529), though the kinds selected are different. Murphy (1936: 1166-67) also quotes several instances of the typical race

laying on bare rocks or ledges, and Moreau (1931 : 780) records it nesting on the cliffs overhanging the quay at Jamestown, St. Helena. These observations are of interest here in view of the White Tern's absence from Christmas Island, which possesses an abundance of suitable vegetation and cliff-ledges.

Nest.—No nest is built. The sitting bird usually leaves its perch by falling away backwards, rather than springing up, in order, presumably, to avoid disturbing the precarious balance of the egg.

Eggs.—Only one egg is laid to a clutch. Its shape is an almost perfect oval. The surface is fine matt. The ground colour ranges from light fawn to olive. It is variously blotched with gull-grey and lilac-grey, and above these with scrawls of dark umber and brownish black, the latter markings being mostly in a ring round the broadest portion of the egg. Fifteen eggs, of which five were taken, measured 40 to 44.5 mm. in length, and 30 to 34 mm. in breadth, with an average of 42.6 × 32.3 mm.

Breeding Season.—In certain parts of its range the White Tern is said to breed throughout the year (Murphy, 1936 : 1167. Vesey-Fitzgerald, 1941 : 529). It is possible that it also does so on the Cocos-Keeling Islands, but if this is occurring it would seem that there is a definite peak period for laying covering the months from May to July, with a recrudescence or possibly a second brood from September to November. All the eggs and young birds that were found fitted in with these two periods, except for an egg seen in March and a chick about two weeks old at the beginning of May.

Incubation.—Both parents incubate, but it was not possible to time the length of the shifts. The eggs were never found unattended, though the sitting birds often left them, partly out of curiosity, when they were approached. The incubating bird does not sit above the egg, but perches behind it, and fluffs the feathers of its breast to cover it. Two full periods were timed to within 24 hours: they lasted 30-31 and 31-32 days respectively. Wood-Jones gives 36 days (1912 : 341). I know of no other records on this point.

Feeding of Young.—The newly emerged chick is fed at short intervals with semi-liquid material regurgitated for it. Later during the second and possibly third week, it is given more solid matter, and after this whole fish, about 1½ to 2 inches long. These are brought to it crosswise in the parent's bill. It is not unusual to see two or three fish carried at the same time in this manner. The fish are mostly *Stolephorus* sp., known locally as *Ikan Bilis* or *Ikan Tĕri*. The parents obtain them either by hovering over still water and picking them from the surface, or by catching them when they are driven into the air by the attacks of larger fish. I never saw the White Tern dive properly. The stomachs of three of the twenty adults examined contained also the remains of small crabs, but I never saw them being caught, or offered to the young.

Fledging.—The young bird emerges covered with a pre-plumule

down, smoky grey in colour, with a varying extent of biscuit brown at the tips. The earliest feathers to appear are those along the middle portion of the dorsal tract and a small patch in each scapular region. These start to sprout through the skin about the eighth day, and appear above the down three to five days later. The remiges, appearing first on the ulna, and the rectrices emerge very soon afterwards. These, together with the long scapular feathers, develop steadily until about the end of the third week. During the fourth and fifth weeks their rate of growth seems to slacken slightly, presumably in consequence of the great development of the covering feathers which takes place at this time. By about the thirty-fifth day apparent down remains only on the forehead, neck, flanks, belly and rump, and in a few fragments adhering to the lesser wing-coverts. By the fortieth day it is reduced still further to a little on the forehead, throat, lower belly and rump. A few forward chicks probably begin to fly naturally at this stage, but the majority do not seem to do so for a further seven to ten days. By then the down is represented by no more than a few whisps round the throat, over the wing coverts and on the lower belly. These are very tenacious, and three apparently independent birds, with total lengths ranging from 290-299 mm., still carried traces on the wings and in the neighbourhood of the vent. The greater part of the juvenile plumage is white, but the upper wing coverts and mantle feathers are richly marked with one or two terminal bars of brownish black bordered by orange rufous, the feathers of the forehead, crown and flanks similarly though less strongly so, and the upper tail coverts faintly so.

Two chicks were measured at intervals of three days to the time they moved away from the nest; a further four were recorded over a part of this period. The figures obtained were broadly similar, and the longest series is given below. This chick was still on the site as late as its forty-third to forty-fourth day, but it was not there when the place was visited again three days later, nor was it seen subsequently. The other chick allowed itself to be lifted up and measured when it was approximately forty days old, but flew fairly efficiently as soon as it was put down, and did not reappear. It should be emphasised that both birds were still far from full grown when the last measurements were taken. Fifteen adults, both sexes, from the same island gave the following figures: total length 310-333, av. 320; gape, 51-56, av. 53; exposed culmen, 39-43·5, av. 40.5; wing flat, 225-241, av. 236; tail, 102-120, av. 108.

Wood-Jones, who provides the only other record of fledgings that I have been able to trace, says that the young birds do not move from the nest-site until they have acquired the full white plumage, and quotes a bird hatched on 3 September which did not fly until it was 70 days old (1912 : 341). The first statement is certainly not correct; see also Murphy (1936 : 1167), referring to the typical race on South Trinidad, 'The chicks are. . . . extraordinarily precocious, and they fly about long before they have lost all the down from the tips of their rusty-tinted white feathers'. The

second is by no means compatible with the records that I obtained. It is perhaps of interest to note that I gave two chicks, which I found when they must have been about three weeks old, to my boatman to rear in his house. They remained healthy, but I am sure from subsequent experiences that he did not give them the amount of food that they would have obtained under natural conditions. They grew much more slowly than the free pair also under observation, and when about 7 weeks old were only as large as the latter had been at 5 weeks. Nevertheless, they flew, though still rather stunted, about ten days later.

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
1	79	20	12	17·5	...	...
4	95	24	14	20	...	...
7	108	27	16	26	...	...
10	120	29	18	30	5	1
13	140	31·5	20	39	16	12
16	165	34	22	54	27	24
19	184	37	24	80	38	34
22	204	38	25·5	99	49	40
25	215	39	26·5	109	52	44
28	223	40	27	116	55	47
31	230	41	28	122	56	50
34	239	42	29	130	58	53
37	249	42·5	30	138	59	57
40	260	43	31	149	60	64
43	274	43	31	160	62	73

Demigretta sacra sacra (Gmel.). *Eastern Reef Heron*

This bird occurs on both Christmas Island and the Cocos-Keeling Islands. It is not plentiful on the former, and is confined to a few suitable points on the east and north coasts. On the Cocos-Keeling Islands it occurs on both the main atoll and North Keeling. The breeding population on the main atoll was about 40-50 pairs. About one-third of these were dark phase birds, and the remainder white. They mixed freely, and in three instances dark and light birds were found breeding together. There can be no question of these phrases being dependent on age, as nestlings acquiring their first feathers were found exhibiting both colour patterns. This bird appears to be strictly resident on both islands.

Situation.—Only one nest was definitely located on Christmas Island. It was a low, rather untidy pile of dried weed, dead *Scaevola* leaves and a few sticks, situated on a rock shelf in a cleft of the sea cliff, about 25 feet above the water. On the main atoll of the Cocos-Keeling Islands the birds were nesting in small colonies in the crowns of coconut palms. The majority were at the south end of the lagoon, on a small island known as Pulo Belanchi, and at the point of West Island (Pulo Panjang) nearest to it. There were also a few pairs at the north end, on Direction Island (Pulo Tikus) and Horsburgh (Pulo Luar).

Nest.—On the main atoll of the Cocos-Keeling Islands the birds were building fairly broad, untidy nests of dead sticks and

Tournefortia leaves. These were about 20 to 25 inches across, and 5 inches deep. The material was only loosely worked together, and in the older nests was held in position largely by the guano.

Eggs.—Twelve nests were examined. Seven had clutches of three eggs, three of four and two of two, but in nearly all cases the birds reared only two chicks. The egg is a pointed oval in shape, with a rough surface. The shell is rather thick. The colour is a uniform light glaucous blue, appearing sea-green when viewed from the inside against the light. Twenty-four examples were measured. They ranged from 42 to 48 mm. in length, and 33 to 36 mm. in width with an average of 46 × 34.5 mm.

Breeding Season.—On the Cocos-Keeling Islands the majority of the eggs were being laid between December and February: the Pulo Belanchi colony was certainly being used for roosting only, from June to November. One fresh nest was found on Direction Island in April. Wood-Jones mentions eggs taken in January, but does not say from which part of the atoll they were obtained (1912 : 342). The Christmas Island nest contained eggs when first discovered in August.

Incubation.—The eggs are probably laid at intervals of 24 to 48 hours. One clutch of four was not completed for 8 days. Both parents incubate. The full period was timed in only three cases. In two of these it was found to be 24 (±1) days from the appearance of the last egg, and in one 25 (± 1) days.

Feeding of Young.—The young are fed by both parents. It was not observed in the case of very young chicks. From the time that the nestling is about three weeks old it raises a considerable clamour when the adult alights near it. This is continued until the bird finally settles on the edge of the nest. The youngsters then move over to it, and as the adult begins to regurgitate, pull its bill down towards them and take the food from it. Much of the food regurgitated during this process falls into the nest, and apparently only a small proportion of the latter is gathered and eaten. The diet of the adult seems to consist chiefly of small fish and various reef crustacea. This material, partially digested, was being fed to the young. On Christmas Island the adults were also occasionally seen searching for grasshoppers and other insects, and one stomach that was examined contained the remains of three large larval *Locusta migratoides* and the elytra of two beetles.

Fledging.—The young bird emerges from the egg almost naked with faintly suggested lines of pre-pennate down along the feather tracts. The feet and skin are greenish yellow, and the bill a dull dark grey. The down becomes rather more prominent as the feathers begin to thrust their way through the skin, but the chick is never adequately covered. The first feathers to appear are on the dorsal and humeral tracts, followed shortly by those on the flanks and wings. The earliest of these pierce the skin between the seventeenth and twenty-first day. By the time that the chick is nearly four weeks old the emerging quills are prominent along all the tracts, and the shoulder feathers are about 20 mm. long. By

the end of the sixth week the chick is well feathered over the back and wings with scraggy feathering on the head and neck. By the end of the next week the head and neck are well covered, except for the superciliary regions. At this stage the feathers on the crown and rump still carry a fair amount of down, and the feathering is deficient at the elbows; this appears to be the last area to be covered adequately. By the tenth week, when the young bird is capable of limited flight, the plumage is complete, except in this region, though the feathers have not reached their full length.

Three chicks, of which one died at the fourth week, were measured at intervals of four days. The figures obtained from one of the survivors are given below: all measurements are in mm. The time of emergence was not known to within 46 hours. The first line of measurements, given as 1 day old, should therefore be taken as 1 ± 1: the others follow at regular intervals from it.

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
1	115	21	14	15	...	...
5	134	25	17	16	...	...
9	148	28	20	19	...	...
13	166	32	23	22	...	...
17	184	37	25	26	...	...
21	202	42	28	30	6	...
25	222	44	30	35	14	...
29	244	47	33	40	22	5
33	270	50	36	56	33	9
37	300	56	39	80	46	14
41	322	60	42	106	60	19
45	342	65	45	130	77	22
49	360	68	48	146	90	28
53	386	73	50	160	98	34
57	410	76	53	180	105	40
61	436	79	56	186	110	46
65	458	82	58	211	113	54
69	488	86	62	228	115	62
73	502	88	65	238	117	70

Both the surviving birds were far from full grown when last seen at the nest. Thirteen adults, both sexes, from the Cocos-Keeling Islands gave the following figures: total length, 545-592, av. 568; gape, 93-105, av. 98; exposed culmen, 76-90, av. 81; wing flat, 252-284, av. 272; tail, 87-104, av. 95.

Sula leucogaster plotus (Forst.) *Brown Booby*

The Brown Booby occurs on both Christmas Island and the Cocos-Keeling Islands. In both places it appears to be strictly resident, and curiously enough was not met with at distances of more than 30 or 40 miles from the land. The population on Christmas Island in 1940 was in the neighbourhood of 5,000-6,500 breeding pairs. These occurred fairly evenly spaced all round the coast.

On the Cocos-Keeling Islands the birds were confined to North Keeling, where in 1941 there were about 75-100 pairs.

Situation.—On Christmas Island the birds were breeding mostly on or near the summit of the sea cliff, and they were seldom seen over the land. A few pairs were making use of suitable ledges on the face of the inland cliff, but they normally flew straight to and from their nests, in marked contrast to the Redfooted Booby which could often be seen gliding up and down above the trees on the shore terrace. The birds on North Keeling were breeding in much the same situation as the Noddies there, the summit of the low shingle ridge between the beach and the beginning of the vegetation on the south and east sides of the island.

Nest.—On both islands the size of the nest varied considerably. In some cases it was as much as 5 or 6 inches high, and over 3 feet across at the base, with a central depression 2 inches deep. In others it consisted only of a sparse lining to a shallow depression scraped in the ground. The materials used were mostly dried twigs and dead leaves, frequently from the *Tournefortia* tree. These were not woven together, but were merely arranged in an untidy heap with which the sitting bird fidgetted repeatedly when agitated.

Eggs.—On Christmas Island the majority of the birds were laying only one egg, but in a count of 50 nests 16, that is 32%, were found to contain two. The second egg would seem to be laid at least two days after the first, and in one instance it was as late as six. The egg is elliptical in shape. The shell is thick with a rough surface. The colour is a uniform bluish white or bluish glaucous, but it is normally covered with a thick coating of lime which rapidly becomes mud-stained and dirty. The size is very variable. Ten eggs on Christmas Island ranged from 56 to 65 mm. in length and 37 to 45 mm. in breadth. An equal number from North Keeling ranged from 51 to 63 mm. in length and 36.5 to 44 in breadth.

Breeding Season.—On Christmas Island the breeding season is indeterminate. Data suggested that the bird may nest in any month, and that different points on the coast have their peak period at different times. The least popular months for eggs appeared to be October to January, and the most popular months between March and May. Individual nesting sites in a number of cases were being used annually between the same dates. In two instances it is certain that the sites were occupied for three successive seasons by the same pair of birds. On North Keeling eggs and chicks of varying ages were found in January and July. The data collected by Murphy (1936: 856-7) give a similar general picture: apparently, within the tropics at least, the populations of this species do not exhibit unanimous breeding seasons.

Incubation.—Both parents incubate, sitting with the feet over the egg or eggs in the manner of the Gannet. It was not possible to time the length of the shifts. The birds remain tenaciously on the nest when approached, and often stand their ground until pushed away from it. Unattended eggs are seldom seen, though

occasionally on very hot days the adult stands by the nest on the sunward side, instead of sitting normally. The incubation period was timed to within twelve hours in six cases. It lasted for between 40 and 43 days. In the cases where there are two eggs the birds usually begin sitting soon after the appearance of the first, and stop as soon as it hatches. The second chick therefore seldom emerges. In the few instances where it was known to do so it did not appear until three to four days after the first youngster, and died within a week. It is probable that its late start resulted in its getting a disproportionately small share of the food available. Chapman (1908: 141), who investigated a large colony in the Bahamas, suggests that a high proportion of the second eggs are infertile, but this did not appear to be the case on Christmas Island.

Feeding of Young.—The young are fed by partial regurgitation. The parent brings the food up into its gullet and the chick puts its head into the adult's open beak to take it. For the first few weeks the material passed over is well digested and almost formless. Later it consists of whole fish, barely affected by the adult's gastric juices. By the twelfth week the fish passed over may be as long as 9 to 11 inches. The adult feeds largely on flying fish, on Christmas Island most of the specimens examined were *Cypsilurus bahiensis* (Ranz.), and to an appreciably smaller extent on squids. No other material was identified with certainty in eleven stomachs examined.

Fledging.—The chick emerges naked and with its eyes closed. The eyes open about the third day, and by the eighth the nestling is thickly covered with a fine, white, pre-plumule down. The earliest contour feathers appear through the skin at about the beginning of the fifth week, in the form of two plaques in the scapular region. By the middle of the sixth week the most advanced of these are approximately 35 to 40 mm. long, and the remiges and rectrices, which emerge about the same time, are both approximately 25 mm. The secondaries project beyond the down on the wing during the eighth week, and by the beginning of the ninth the scapular patches have united in the midline, and the rectrices are sufficiently developed to form a good, strong fan. By this time the down is growing thin behind the eyes and over the breast. By the twelfth week it survives only on the head, neck, thighs, flanks and, in fragments, among the secondaries. The remaining down disappears during the next two weeks, the last to go usually being a small tuft on the crown of the head, like the lock of hair by which the Irvingites hoped to be lifted to heaven. By the fourteenth to fifteenth week the young bird is practically full-grown and capable of a limited flight. At this point it makes occasional experimental excursions, gliding back to its nest to wait to be fed at the end of them. During the next two weeks these flights become longer and more frequent, until ultimately the young bird is away for so long that the adults lose interest in the site. Thus the young Brown Booby, like the young Gannet, may be said to abandon its parents, rather than to be abandoned by them.

Four chicks were measured at intervals of seven days up to about the fifteenth week. The figures obtained were all broadly similar, except that the difference of size due to sex became apparent between the fifth and seventh weeks. The figures obtained from one of these, a young male, are given below:

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
2	152	29	19	21	...	...
9	257	47	33	29	...	...
16	341	63	47	42	...	...
23	385	76	59	65	...	...
30	447	88	70	100	5	3
37	490	98	79	132	22	20
44	557	107	86	164	47	48
51	611	109	91	190	72	74
58	652	112	93	233	96	108
65	676	114	94	258	112	134
72	698	115	95	284	119	160
79	749	116	96	331	121	176
86	764	116	96	362	122	189
93	779	117	96	390	120	201
100	783	117	97	394	120	203
107	788	117	97	396	120	201

Sula sula rubripes (Gould) *Redfooted Booby*

The Redfooted Booby occurs on both Christmas Island and the Cocos-Keeling Islands. In both places it appears to be strictly resident, but it may be met with at distances of nearly 300 miles from the land. The population on Christmas Island in 1940 was about 4,500-6,000 breeding pairs. On the Cocos-Keeling Islands the birds are confined to North Keeling, where in 1941 there were about 3,500-4,000 pairs.

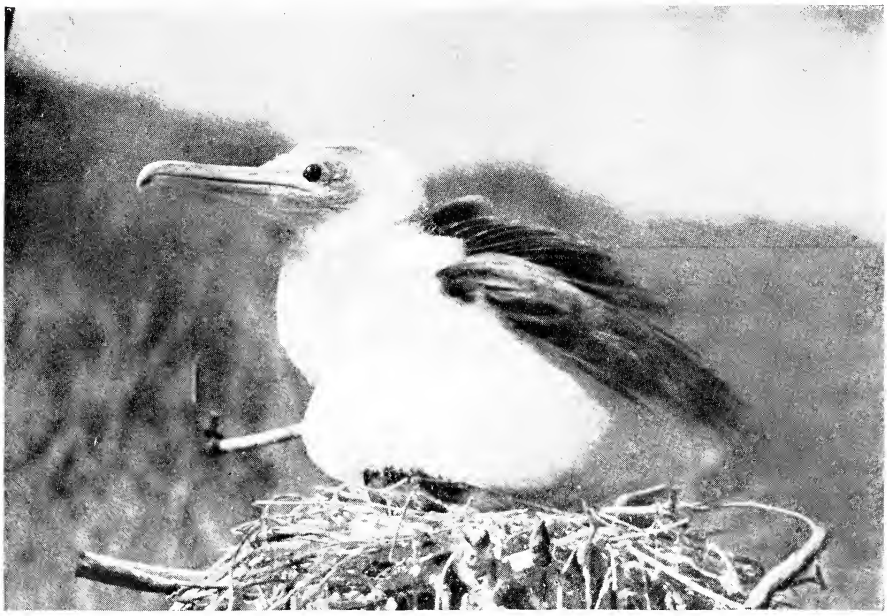
Situation.—On Christmas Island this bird occurs mostly on the north and east coasts. Unlike the preceding species it spreads widely over the shore terrace, and it may even roost in trees on the lower slopes of the inland cliff. The nests are invariably placed in trees. In the neighbourhood of the beaches and above the sea cliff it usually makes use of *Tournefortia* trees, building at a height of 15 to 25 ft. from the ground. A little further inland it often nests in much larger trees, sometimes sharing them with colonies of the Christmas Island Frigate-bird. In this situation the trees chosen are usually *Gyrocarpus americanus* and *Terminalia catappa*, and the nests 50 to 80 feet above the ground. On North Keeling the nests are mostly in *Tournefortia* trees overlooking the lagoon, and at a height of 15 to 25 feet.

Nest.—On both islands the nest is an untidy platform, about 12 to 15 inches across, of dried twigs, sparsely covered with dead leaves. The central depression is usually less than two inches deep. The whole structure is carelessly built and loosely knit, and begins to disintegrate before the egg hatches. Frequently it is

Chick of the Red-footed Booby, aged about 42 days

Photos *C. A. Gibson-Hill*

Chick of the Least Frigate-bird, aged about 20 days, with an adult male.



Chick of the Christmas Island Frigate-bird, aged about 55 days.

Photos *C. A. Gibson-Hill*

Male Least Frigate-bird, with pouch distended.

represented by only a few sticks by the time that the chick is fully fledged.

Eggs.—On both islands this bird lays only one egg to a clutch. The eggs are similar in shape and colour to those of the Brown Booby. Ten examples measured on Christmas Island ranged from 56 to 59 mm. in length, and 36 to 40 mm. in breadth. Ten on North Keeling, of which five were taken, ranged from 56 to 62 mm. in length, and 37.5 to 40 mm. in breadth; average 58.8 × 38.3 mm.

Breeding Season.—Unlike the Brown Booby this bird has a limited and definite breeding season on both islands. On Christmas Island nests are built from the middle of April to the beginning of June, and the eggs mostly laid from the last week of May to the end of June. The majority of the young birds start to fly in October and November. On North Keeling there were no signs of reproductive activity in January; in July most of the pairs had nests containing well incubated eggs or young birds, placing the egg-laying period from the beginning of April to early June.

Incubation.—Both parents incubate, and seldom leave the egg unattended voluntarily. The incubation period was timed to within 48 hours in five cases. It lasted for 39-42 (±1) days from the appearance of the egg. Campbell (1901), writing of birds off the Australian Coast, gives 45 days.

Feeding of Young.—The feeding of the young is very similar to that in the Brown Booby, except that it was most noticeable that parents returning to the colony before they were ready to regurgitate would perch on a neighbouring branch six to ten feet from the nest. The diet of the adults, and therefore of the chick, is the same as in the Brown Booby, except that these birds take a much higher proportion of squids. Fifteen stomachs were examined on Christmas and the Cocos-Keeling Islands and only five of them contained the remains of freshly digested fish. In all cases the remaining substances were apparently cephalopods.

Fledging.—Post-oval development is broadly similar to that in the Brown Booby, but rather slower in the initial stages. A further small difference would seem to be that the scapular feathers appear later, and also grow more slowly at first. The young bird often adopts a peculiar posture on the nest from quite an early age, lying flat on its belly with its neck stretched out, and its head and bill projecting over the edge. Juveniles can sometimes be seen balancing on branches in a similar position. Four chicks were measured at intervals of seven days from within one or two days of hatching, and a further eight from the fifth to seventh weeks onwards. The figures obtained displayed no marked differences. One of the longer series is given below: all measurements are in mm. This bird was near the nest site on the 114th day, but it was not identified subsequently. Two birds were seen as late as their seventeenth and nineteenth weeks, but in no case was it possible to catch one for examination after the sixteenth week. The chicks were only marked with rings of coloured string, and it is of course possible that these were lost soon after they began to fly.

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
2	138	25	16	20	...	...
9	188	33	23	23	...	...
16	237	43	31	30	...	...
23	292	55	41	40	...	...
30	347	63	49	53	...	...
37	386	71	56	66	...	6
44	450	80	64	80	2	31
51	495	84	68	112	12	50
58	535	89	72	160	32	78
65	574	91	74	199	52	102
72	622	93	76	234	79	129
79	653	95	77	264	96	147
86	674	96	78	285	107	165
93	691	97	80	308	115	181
100	703	96	80	333	119	191
107	714	98	80	354	119	200

Fregata andrewsi (Math.) *Christmas Island Frigate-bird*

This bird occurs only on Christmas Island, where it is accompanied by the typical race of the Lesser Frigate-bird, *Fregata minor minor* (Gmel.). Two Frigate-birds also occur on North Keeling, races of *F. minor* and of the Least Frigate-bird, *Fregata ariel* (G. R. Grey), the sub-specific designation of which has not yet been determined. In 1940 there were about 1,000 to 1,500 breeding pairs of *F. andrewsi* and 2,000 to 3,000 pairs of *F. m. minor* on Christmas Island. No previous field notes appear to have been made on *F. andrewsi,* other than those given in the short account by Andrews (1900: 42-4).

Situation.—The distribution of *F. andrewsi* on Christmas Island follows that of the Redfooted Booby. It is most plentiful on the north coast and the northern portion of the east coast. It is relatively scarce on the south and west side of the island, where to a large extent its place is taken by the Lesser Frigate-bird. It roosts and breeds almost entirely in the tall trees on the outer portion of the shore terrace. It seldom penetrates further inland, and it is rarely seen over the plateau. The greater number of the nests are in *Terminalia catappa* Linn. It also breeds to a lesser extent in a species of *Grewia* and, more rarely, *Gyrocarpus americanus* auctt. The birds are gregarious and one usually finds between three and ten pairs close together in the same tree. Frequently a site is used year after year, and the new nest built on the guano-cemented remains of the old one.

Nest.—The finished nest is an untidy, flat platform of dead sticks and pieces of dried creeper, 15 to 20 inches across, with a shallow central depression. The construction is loose and careless, and often the fresh material is represented by less than a dozen sticks by the time that the chick is fully fledged. The material is obtained by the birds picking dead twigs and leaves from the trees as they glide or hover over them. The urge to do this appears to be deeply rooted in the bird's behaviour pattern, and one often saw small groups of juveniles following each other over a tree, and attempting to remove a particular leaf as they passed. It seems

probable that work on the nest is begun by the male before the birds have paired. As, however, these pieces are easy to move, the additions are often stolen by neighbouring birds as soon as it leaves the site. After the birds have paired the male remains for long periods on the nest, which it guards, and the female brings back occasional sticks when returning to it.

Eggs.—The Christmas Island Frigate-bird lays only one egg, and it would appear that if it is destroyed it is not replaced. It is similar in shape and colour to those of the other members of the genus. No examples were measured. Stuart Baker (1929: 296) gives a fuller description, presumably based on specimens collected by Andrews in 1908.[1]

Breeding Season.—This bird has a fairly definite breeding season. On Christmas Island courtship, among the more precocious birds, begins at the end of January, and nest building during the following month or early in March. Eggs are laid between the end of April and the beginning of June. The majority of the nests contain a downy chick by the middle of July. The oldest of these start to fly in October, and the remainder in November and early December.

Incubation.—The male bird does the greater part of the incubating, but the female also broods to an extent which shows considerable individual variation. In two nests which I observed the female was present more often than the male. During the first two to three weeks of incubation the male often sits with his gular pouch fully distended. When the female arrives to relieve him there may be a considerable display of bill clopping and mutual preening. Later the pouch begins to atrophy, and by the time that the egg hatch it is no longer inflated, and is usually represented externally by only a thick wattlelike dewlap. Incubation was not timed in its entirety, but the period is certainly over 40 days.

Feeding of Young.—For the first few weeks the young chick is guarded carefully. If left unattended for any length of time birds from the neighbouring nests may attempt to dispose of it. Initially the guarding is done mostly by the male, while the female brings the greater part of the food. As in the boobies this is carried in the crop and regurgitated into the gullet when suitably digested. The young bird puts its bill and head into the parent's bill to take it. The adults take some time to arrive at a state in which they are willing or able to bring the food up. They could sometimes be seen sitting on a branch near the nest, gulping ineffectually at

[1] This is only a presumption. Andrews does not appear to have collected any eggs, which are extremely difficult to reach, during his first visit to the island. On the other hand, Stuart Baker's notes on nidification, quoted below, are so inaccurate that he may have confused this species with another from a different island.

'The Christmas Island Frigate-bird breeds in large colonies, making a rough nest of sticks and weeds, which it places either actually on the ground, or within a few inches of it in the scrubby growth on the shores above high-water mark. The eggs number one or two and are all pure white, in shape like those of the Gannet but without any chalky covering and decidedly more fragile. They measure about 70.4×50.4 mm. but a larger series than mine would probably give much smaller measurements.'

intervals, for over an hour. When ready they move to the nest, and are immediately attacked by the chick, which calls clamorously, with a rather ratlike squeak, throughout its wait.

When the chick is very hungry it will pester the bird sitting by it as though it had brought food. Probably partly as a result of this the male becomes increasingly less attentive as the youngster grows older. At first he spends some time sitting near the nest, but out of reach of the chick. Later his periods even near the nest decrease in length, until finally towards the end of the fledging period he appears only as an occasional visitor. The female, on the other hand, continues to bring food regularly, and though she is assisted to some extent by the male when he is not guarding the chick, she does the greater part of the work.

Fledging.—The chick emerges naked, but rapidly develops a thick covering of long, fine, pre-plumule down. Initially this is white, but later it is replaced by a rather coarser plumule down which is a pale smoky grey on the dorsal surface, the back of the neck and the sides of the breast. The earliest contour feathers, in the form of two scapular plaques, begin to thrust through the skin at the same time as the down, and thus the chick never has a complete covering of down only, as in the young boobies. Also in the latter birds the earliest remiges and the rectrices appear with the mantle feathers, or may even begin to emerge before them. Here there is a long interval between the two groups. The scapular feathers grow rapidly and the patches extend, so that by the fifth week there are two parallel bars of dark feathers down the back and a cluster at each shoulder. The greater coverts of the outer secondaries appear during the sixth week, and those of the inner primaries during the seventh. It is interesting to note again that these coverts long precede the appearance of the remiges themselves, and are about 75 mm. in length before the latter pierce the skin. From this period onwards, while the greater development of the remiges is taking place, the chick normally rests with its wings drooping so that the terminal portion is supported on the nest. During the twelfth week the lesser coverts along the anterior margin of the wing appear at the wrist, and start to work inwards, completing their course by the sixteenth week. At the thirteenth or fourteenth week the chick still has the belly, chest, rump and greater part of the body of the wings covered with down. The saddle-shaped area of olive-brown feathers, which appeared first in the scapular region, has spread to cover the whole of the back and is advancing towards the nape of the neck. During the next two weeks feathers appear on the sides of the breast and begin to work medially towards the midline. By the twentieth week down remains, in an appreciable amount, only on the lower breast and belly, though there is still some present among the wing coverts. At this stage the wing and tail measurements of the chick are only 10-15% less than those of an adult of the same sex, while the bony structure as represented by the tarsus and skull, is virtually full-grown. The young bird, however, though there is probably little of the nest left, is reluctant to fly, and may not do so until as late as the twenty-second or even twenty-third week. The young of

F. andrewsi do not therefore take to the air voluntarily until their wings and tail are nearly complete. Even then the parents continue to feed them for several weeks.

Growth measurements at intervals of seven days were begun on three chicks when they were approximately 30, 40 and 45 days old, but it was only possible to follow the youngest of these to the point at which the bird left the nest. The measurements obtained are given in mm. below.

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
30	380	86	69	60	76	...
37	422	94	76	75	112	6
44	466	100	82	88	138	18
51	535	108	91	105	149	35
58	590	110	96	133	170	60
65	640	114	98	163	187	80
72	665	118	101	197	194	102
79	681	120	104	232	200	120
86	710	122	106	254	209	158
93	735	126	109	292	215	180
100	759	129	110	339	222	205
107	782	131	111	368	224	228
114	808	132	112	405	225	252
121	832	132	112	440	224	276
128	852	133	113	474	224	294
135	870	133	113	505	224	310
142	887	133	113	542	224	326

Phaëthon rubricauda westralis Math. *Redtailed Tropic-bird*

The Redtailed Tropic-bird occurs on both Christmas Island and the Cocos-Keeling Islands. It is fairly plentiful on the former, and in 1940 there were about 400 to 600 breeding pairs. It is relatively scarce on the Cocos-Keeling Islands, and was only seen at fairly wide intervals: one nest was found, on Horsburgh Island. On Christmas Island at least the adult birds are apparently resident, and there is no appreciable seasonal variation in their numbers. They may, however, be met with anywhere over the open sea between the two islands, and as far north as Java Head. On Christmas Island they fly fairly freely over the land, though they are not seen above the central plateau as often as *P. lepturus fulvus* Brandt. The young birds go out to sea when they leave their nests and no examples in immature plumage were seen in the vicinity of the island.

Situation.—On Christmas Island nests were found only on ledges on the steep portions of the inland cliff, or on the crest of the cliff itself, at heights of 200 to nearly 600 ft. above sea level. Some of these nests were set fairly deeply in small crannies into which the birds could barely penetrate. Others were on more open ledges, but in these cases they were usually under the shelter of a bush or an overhanging rock. The single nest on the main atoll of the Cocos-Keeling Islands was on the ground, under the shelter of a bush, among coconut palms about 50 yards from the sea.

Nest.—The single egg is deposited in a slight depression in the earth. There is usually no lining. The birds appear to make no

attempt to gather twigs or leaves, but if there are a few pieces lying on the ledge itself they may be arranged to form a bed for the egg.

Eggs.—Only one egg is laid to a clutch. It has a thick shell, with a fine matt surface. Five examples taken on Christmas Island ranged from 68 to 71 mm. in length, and 47.5 to 50 mm. in breadth. The Cocos-Keeling egg measures 63.5 by 44.5 mm. The colour is variable. It may be a very pale terre verte, with a few fine purplish black smudges, like smuts, mostly at the broader end, or pink, covered thickly or thinly with dark purplish horn or purplish black streaks and specks. Stuart Baker (1929: 293) quotes two eggs in his collection 'from an Island near Mauritius', the typical race, as 64.6 × 49.3 and 70.8 × 49.3 mm.

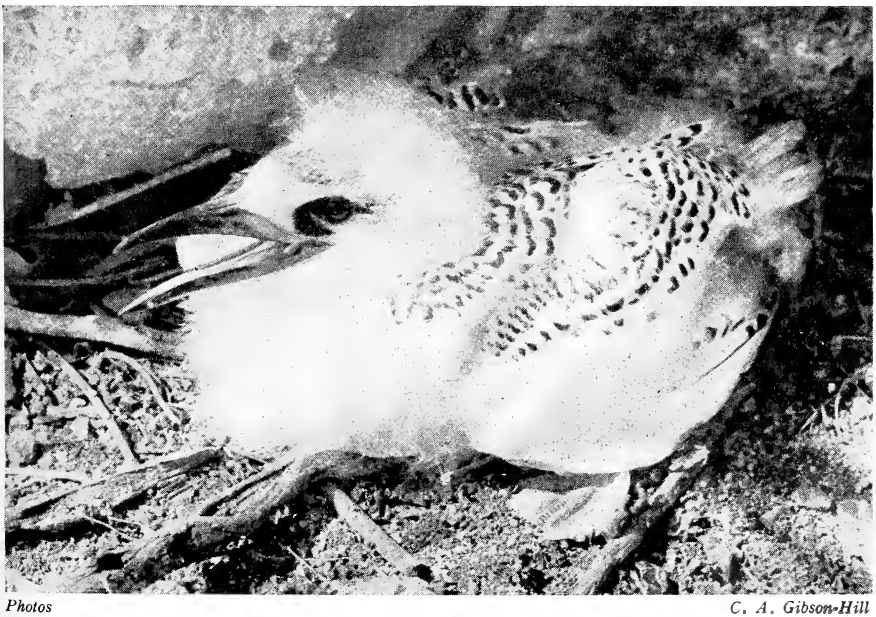
Breeding Season.—The breeding season on Christmas Island is definite but extended. The majority of the eggs are laid in May and June, with a few stragglers carrying on until the first half of September. Most of the nests contained downy chicks in July, and juveniles in full speckled plumage in September. The majority of the young leave the nests during October. The single egg from the Cocos-Keeling Islands was taken on 20 September.

Incubation.—There is no doubt that both parents incubate, but it was unfortunately not possible to time the length of the shifts. The egg is not normally left unattended for long. The birds not sitting spend a great part of the afternoon flying overhead in the neighbourhood of the nests, calling to their mates each time that they pass. Sometimes the latter answer, but frequently the sitting birds spend the greater part of the time asleep. The full incubation period was not recorded, owing to the difficulty of locating a nest site before the appearance of the egg, but in one case it was over 36 days, and in another over 44 days. Gross (1912) gives 28 days for the allied *P. lepturus catesbyi* Brandt in the Bermudas; Plath (1912: 558) obtained the same figure for *catesbyi* from an egg hatched in an incubator.

Feeding of Young.—The young chick is fed by regurgitation, the adult inserting the tip, and later almost the whole, of its bill into the chick's gullet to do so. For the first three to four weeks the parents visit the young bird frequently, and at all times of the day. Food given at this stage is well digested and semi-fluid. Later more solid material is brought, and feeding takes place largely shortly after sunrise. Judging from the material vomited by recently fed youngsters their diet consists chiefly of cephalapods, and only a small proportion of fish fragments (Gibson-Hill, 1947*a*: 658-61).

Fledging.—The young chick emerges covered with a fine, white, powder-puff down. This differs from the down in the young *Fregata* and *Sula* in being, age, for age, longer and softer, and prepennate not pre-plumule. The first contour feathers start to sprout in the scapular region at the end of the third week and are followed soon afterwards by the outer primaries. The next feathers to appear are the rectrices, and then the secondaries and greater coverts, all of which are visible by the fifth week. It is interesting to note that in contrast to *Fregata* the remiges appear before their coverts, and

Young chick of the Red-tailed Tropic-bird, aged about 15 days with an adult bird.



Photos *C. A. Gibson-Hill*

Chick of the Red-tailed Tropic-bird, aged about 60 days.

the outer primaries before the inner ones. From the beginning of the sixth week the coverts spread along the wing, and by about the middle of the ninth week the young bird is almost entirely feathered on its upper surface. Down, however, still remains on the belly, flanks, axillary regions and along the anterior edge of the wing. Within the next two weeks, that is by about the eleventh week, most of the remaining down disappears, except for fragments among the wing coverts and the feathers of the lower breast, belly and flanks. In the latter situation it is not conspicuous, but may remain for several weeks. The young bird is now virtually in the complete immature plumage, but it does not usually leave the nest for a further three to four weeks or even longer.

Unlike *Fregata* and *Sula* the young bird is abandoned by its parents. Three chicks that I was watching were certainly not visited in the last 8 to 12 days before they themselves disappeared from the nest. It would seem that the chicks are usually about 12 weeks old when the parents leave them, and 13 to 14 weeks when they themselves fly for the first time. Juvenile birds move out to sea as soon as they leave their nest, and remain there until mature. There was a fairly large colony within a mile of the bungalow in which I lived for over two years, and I never once saw an immature bird in flight over or near the island.

Six chicks were measured at intervals of seven days to within a week of their leaving their nests. The figures obtained were broadly similar, and one series is given below: all measurements are in mm.

Approximate age in days	*Total length*	*Gape*	*Culmen*	*Wing flat*	*Longest scapular feather*	*Longest rectrices*
1	165	41	15	22	...	...
7	207	82	21	33	...	...
14	245	52	28	43	...	...
21	275	62	35	52	15	...
28	315	71	41	70	30	7
35	347	75	46	101	52	13
42	389	81	49	140	70	35
49	431	87	53	185	88	48
56	452	91	56	204	102	67
63	473	92	58	236	109	84
70	502	92	59	270	114	98
77	515	92	60	289	112	113
84	523	92	60	314	112	120
91	532	92	61	334	113	122

An analysis of these figures shows that the bill grows fairly rapidly during the first 4 or 5 weeks, and then slows down as the feathers begin to appear. By between the seventh and eighth week the ratio, between the gape and culmen is within 10% of the adult figure. This development results in an interesting change in the shape of the bill, which initially is rather like a squat version of that of the Gullbilled Tern. The only significant difference between this race and the typical race *P.r. rubricauda* is in the greater length of the exposed culmen in the latter. Fourteen adults of *P.r. westralis* from Christmas Island have a range of 58 to 65 mm.

while according to Mathews (see Chasen, 1933: 77) examples of *P.r. rubricauda* range from 76 to 80 mm. Since, apparently, development of the bill in front of the nostril virtually ceases when feathering gets well under way, it might be said that the difference between the two races is really determined either by the point in time at which feathering starts, or the rate of the chick's growth before it begins. It could therefore be merely due to the diet, in that if the chick were to grow slowly owing to a shortage of food for the first 4 or 5 weeks, its culmen would be shorter when growth in that region stopped than if it had been fed lavishly.

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A NOTE ON THE MEASUREMENTS

The measurements given at the ends of the sections on fledging in this paper are in each case those of a single individual chick. I am not satisfied that this provides sufficient information, and I would have preferred to have been able to list all the measurements taken. Unfortunately this is not possible now. All my field notes, except for two note-books, were left hidden in the Raffles Museum when I went into internment in February 1942. They were discovered and removed during the occupation. None of the material has come to light since the end of the war, except for the draft of an earlier paper on the birds of Christmas Island (1947b), the selected data quoted in this paper, and the majority of the collected specimens. Accordingly this paper, like my others on the fauna of these two islands, has been written with only a portion of the original material in front of me, and I now have little data beyond that contained in it.

It is, of course, also doubtful if any detailed series of measurements can be regarded as representative, no matter how many birds are used. Chicks of the sea birds often vomit when they are being examined, and accordingly those which are measured regularly at short intervals receive rather less food than those that are never molested. The total effect is not likely to be considerable, but I think that if a series of such chicks were measured once only, at a known number of days after hatching, they would be found to be about 5% larger than in the instances quoted. While I was on the Cocos-Keeling Islands I gave young chicks of *Demigretta s. sacra* and the frigate-birds to my boatman to feed and bring up in the compound of his house. I am sure that he did not underfeed them intentionally, but there is no doubt that they completed their feathering while their bony measurements were still between 15 and 10% below that of an average free-flying juvenile. It is possible that this factor, relative shortage of food, was responsible for the apparent slowing down of development recorded in the two chicks of *Gygis alba monte* during their fourth and fifth weeks. The two birds were developing simultaneously, and bad weather during this period may have reduced the fishing activities of their parents. Unfortunately I no longer have either my weather records or the dates to show exactly when the measurements were taken.

A NOTE ON THE PLATES

1. A Noddy chick, aged about 23 days, on the nest site, with one of its parents standing by it. By this stage the down is represented only by a few fluffy fragments adhering to the feathers of the belly, wing coverts and gular area. (Christmas Island.)
2. A chick of the White Tern, aged about 35 days. (Horsburgh Island, Cocos-Keeling Islands.)
3. A chick of the Brown Booby, aged about 4 days, on its nest. (Christmas Island.)
4. A chick of the Brown Booby, about 65 days old. The down is beginning to disappear from the forehead and behind the eyes, and is growing thin at the sides of the breast. (Christmas Island.)
5. A chick of the Redfooted Booby, aged about 42 days, with one of its parents. The young bird is bowing down in agitation, as it usually does when the nest site is approached. The pose is characteristic of the species, and does not occur in the ground-nesting Brown Booby.
6. A young chick of the Least Frigate-bird, with the male parent perched by it: probable age about 20 days. The picture shows the shape and early development of the patch of mantle feathers. (North Keeling.)
7. A chick of the Christmas Island Frigate-bird, about 55 days old. The picture shows the great development of the mantle feathers, and the characteristic resting posture at this age, with the wing drooping and its terminal portion resting on the nest.
8. Adult male of the Least Frigate-bird sitting on the nest site with its gular pouch fully distended. (North Keeling.)
9. A young chick of the Redtailed Tropic-bird, with one of its parents. The chick is still in the powder-puff down stage, and about 15 days old. (Christmas Island.)
10. The same chick, aged about 60 days.

SUMMARY

A short account is given of the nesting habits of seven representative tropical sea and coastal birds, covering the genera *Anous, Gygis, Demigretta, Sula, Fregata* and *Phaëthon,* as observed on Christmas Island and the Cocos-Keeling Islands (both in the eastern Indian Ocean). The data are arranged in sections devoted to the situation of the nest, nature of the nest, eggs, breeding season, incubation period, feeding of the young, and fledging. Reference is made to relevant data from other tropical islands where they appeared to be of interest in relation to the original observations recorded here.

THE INDIAN CADDIS FLIES (*TRICHOPTERA*).

BY

THE LATE MARTIN E. MOSELY, F.R.E.S., F.Z.S.

PART IX

(*With* 14 *plates*).

(*Continued from page* 781 *of Volume* xlii, No. 4, 1941).

SERICOSTOMATIDAE McLACHLAN. (*Continued.*).

LEPIDOSTOMATINAE Ulmer (*Continued.*).

[My colleague, Martin E. Mosely died in August, 1948, at the age of 71, and having been associated with him in his work for a long time, I have been asked to prepare for press his unpublished manuscripts. His work on the Indian Caddis Flies was completed to the end of the Sericostomatidae some years ago, but the publication was delayed by the war and lack of funds. There is now little likelihood of the series being continued for a long time, but the publication to the end of the Sericostomatidae completes the suborder Inaequipalpia, and thus rounds off the work already done, and with the eight parts already issued provides a workable text book to part of the Indian Caddis Flies.

D. E. KIMMINS,
Dept. of Entomology, British Museum, Nat. Hist.]

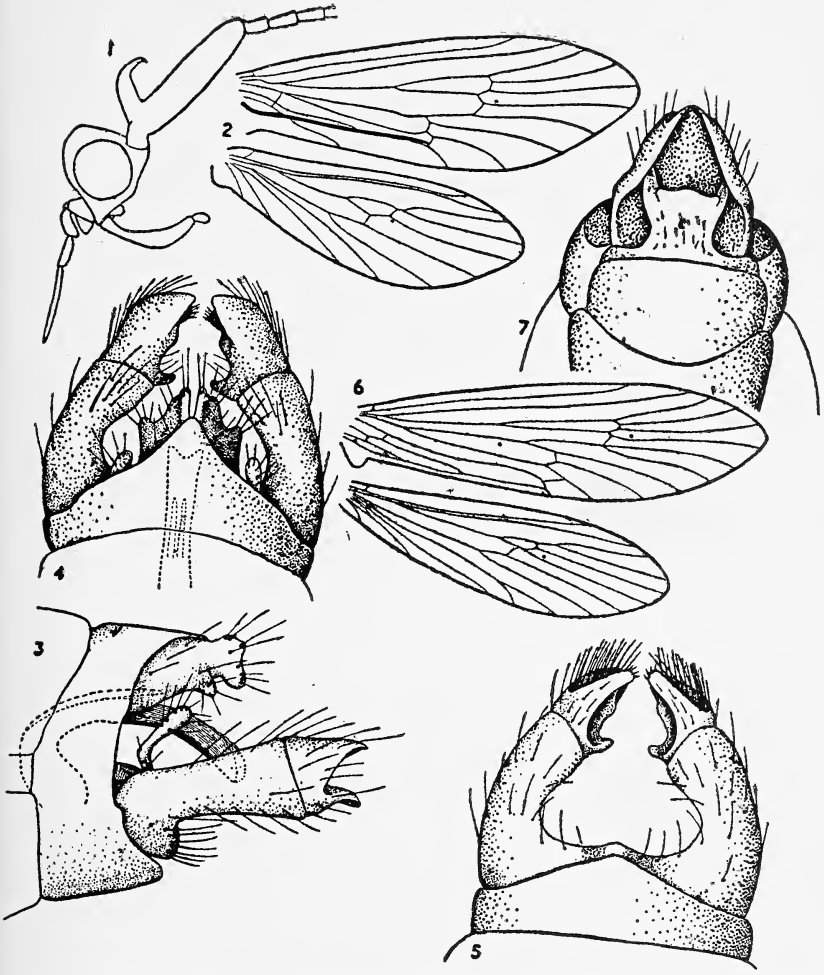
Adinarthrum gen. n.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna rather short and stout, with a single process towards the base. Maxillary palpi two-jointed, joints varying in proportion in the species. Wings clothed with hairs and scales; in the anterior, post-costal fold about half the length of the wing, with only two cells between it and the lower margin of the wing. Penis sheaths long. Inferior appendages apparently two-jointed, terminal joint short, simple in most species but furcate in *A. iamba*; the upright branch at the base of the appendage very slender.

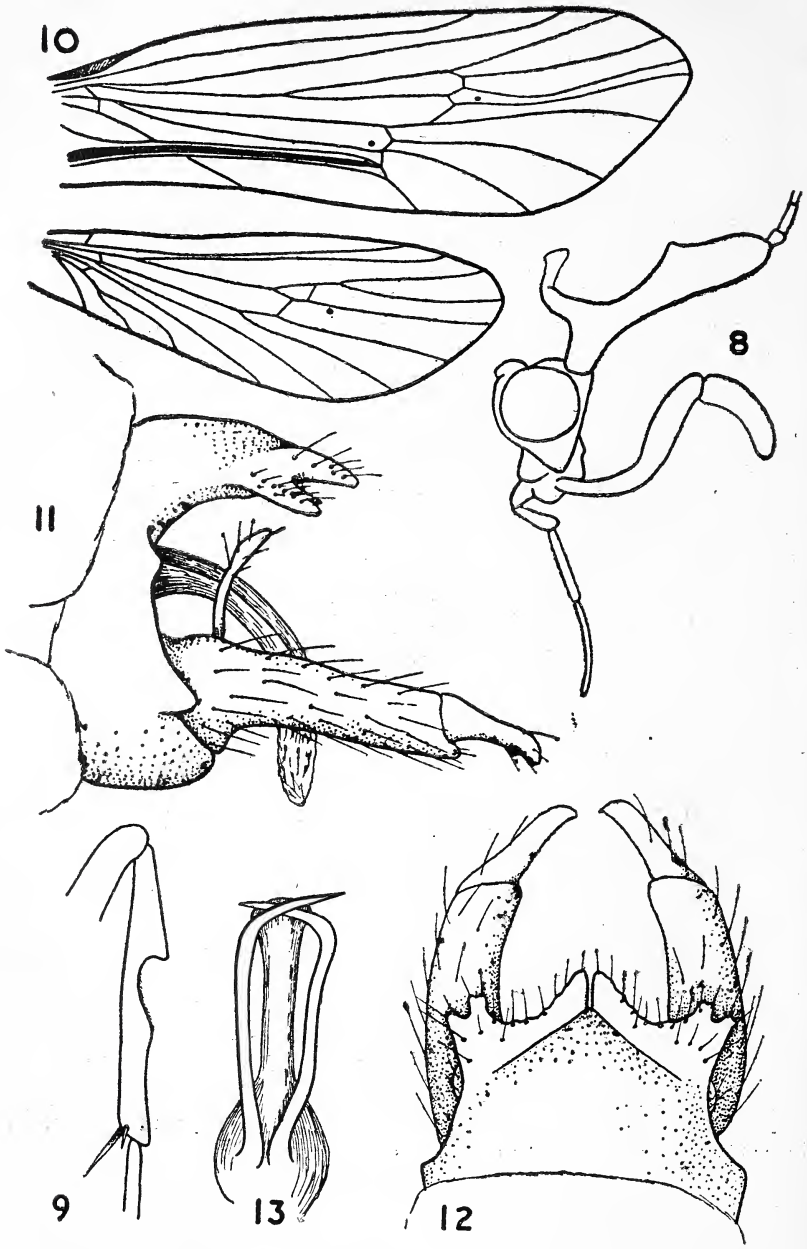
Genotype.—*A. kurseum* sp. n.

Adinarthrum iamba sp. n. Figs. 1-7.

Insect brown; antenna with basal joint not very long, armed with a single process near the base; the process is large, broad at the base and hooked; it is directed inwards and upwards, tapering to an acute claw; above the process, the joint is somewhat



Figs. 1–7. *Adinarthrum iamba* sp. n. 1, ♂ head from side. 2, ♂ wings. 3, ♂ genitalia, lateral. 4, ♂ genitalia, dorsal. 5, ♂ ninth segment and inferior appendages, ventral. 6, ♀ wings. 7, ♀ genitalia, ventral.



Figs. 8–13. *Adinarthrum kurseum* sp.n. ♂. 8, head from side. 9, anterior tibia of type. 10, wings. 11, genitalia, lateral. 12, genitalia, dorsal. 13, penis and sheaths, dorsal.

hollowed on its inner surface; the vertex of the head is raised in a triangular prominence between the bases of the antennae; maxillary palpi two-jointed, membranous, clothed with the usual thickened hairs, basal joint long, terminal joint short; labial palpi with the first and second joints approximately equal and scarcely half the length of the third; wings clothed with hairs and scales, anterior with no median groove, post-costal fold terminating in a rather small cell; discoidal cell long and narrow; fork No. 1 sessile but not overlapping the discoidal cell; in the posterior wing, fork No. 1 with no median groove, post-costal fold terminating in a rather further inwards than the basal angle of the discoidal cell.

Genitalia ♂—Ninth tergite produced in a large triangle, beyond which is a dorsal plate consisting of a pair of broad plates set on edge and separated by a narrow excision; these plates, from the side, are very deep, apical margins truncate, slightly excised and with small, rounded processes arising from the lower margin, somewhat outstanding, so that they are visible from above; penis broad, curving downwards with a pair of short sheaths set very far back towards its base; inferior appendages two-jointed, basal joint very stout and curved, with a short, upwardly and distally directed branch arising from its upper margin towards the base; terminal joint short and broad, bifurcate, upper fork broader than the lower and superimposed above it; from above, the lower fork bears a rounded excision on its inner margin, leaving a projecting spur.

Length of the anterior wing ♂ 6 mm., ♀ 5·75 mm.

Length of the basal joint of the antenna ♂ 0·88 mm.

N.-E. Burma: Kambaiti, 6,800-7,000 ft., 4, 6, 10, 30. iv, 6, 11, 12. v. 1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ and ♀ in the Stockholm and the British Museum collections.

Figures of the ♀ genitalia and wings appear in this description but it must be stated that the association of the sexes is based merely on the relative numbers of the examples of the two sexes collected on a particular day in a particular locality.

Adinarthrum kurseum sp. n. Figs. 8-13.

General appearance dark brown; in the male, basal joint of the antenna rather short, with a stout basal projection terminating in a transparent finger, bent at right angles, with an obliquely truncate apex; beyond this distally, the margin is first widely excised and then produced in a triangular projection; second joint about half the length of the third, remaining joints broken away in the type; maxillary palpi two-jointed, basal joint rather more than twice the length of the terminal joint, both densely covered with thickened hairs; labial palpi with the second joint longer than the first and shorter than the third; legs, each fore-tibia in the type aberrantly notched on its upper surface (normal in the paratype); spurs 2, 4, 4; anterior wing clothed with hairs and scales, a fold running parallel with the post-costa, discoidal cell long and

narrow; in the posterior wing, fork no. 1 with a foot-stalk, discoidal cell stout and triangular; in the paratype, from the Khasia Hills, the discoidal cell is apparently open.

Genitalia ♂—The ninth dorsal segment is produced in a broad triangle, beyond which is a dorsal plate divided by a narrow excision at its produced centre, and with the outer angles each produced in a pair of short, blunt forks; the form of these outer angles appears to be variable and in the paratype, the outer angles are produced in single processes; penis slender and downcurved, sheaths symmetrically crossing at their apices; inferior appendages two-jointed and branched; from above and beneath, the appendages are caliper-shaped, apex of the basal joint projecting on the inner side to make a small, rounded branch; seen from the side, there is a slender, upwardly directed branch arising from towards the base on the upper margin.

Length of the anterior wing ♂ 7·5 mm.

Length of the basal joint of the ♂ antenna 1·3 mm.

Sikkim: Kurseong, 5,000 ft., 21. iv. 1922, Fletcher coll. (Type) Assam: Khasi Hills, McLachlan coll.

Type and paratype ♂ ♂ in the collection of the British Museum.

Adinarthrum moulmina sp. n. Figs. 14-19.

Insect light brown. In the ♂, basal joint of the antenna comparatively short, very stout, basal branch stout with a terminal, semi-transparent plate; just beyond its centre, the inner-upper margin is strongly dilated to form a triangular projection, lower margin straight; maxillary palpi two-jointed, basal joint sinuous, terminal joint long and stout; wings covered with hairs and scales, costa not folded; post-costal fold slightly longer than half the wing, terminating in a large cellule and with only one large cellule between it and the posterior margin, a smaller, narrow cellule towards the base; discoidal cell much shorter than its footstalk, wanting in the posterior wing.

Genitalia ♂—The apical margin of the ninth segment produced in a wide triangle; dorsal plate with a pair of short, somewhat rounded central lobes, separated from wide triangular projections of the lateral angles by deep, rounded excisions; penis slender and down-curved; sheaths long, apices crossing; inferior appendages branched and two-jointed; a branch arising from the upper, basal margin, slender, directed upwards, slightly curved; basal joint of the appendage long and slender from the side, terminal joint very short.

Length of the anterior wing ♂ about 7 mm. (incomplete)

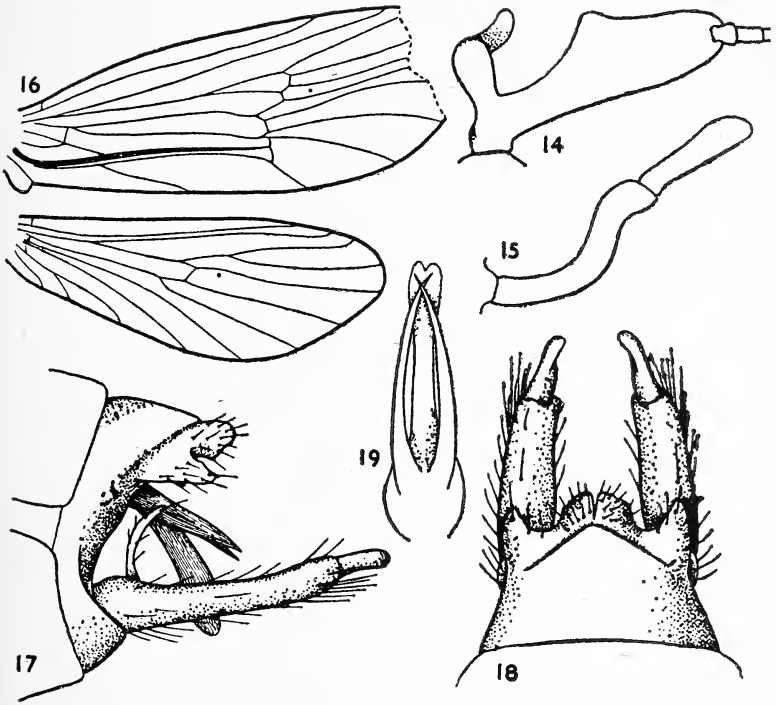
Length of the basal joint of the antenna 1·2 mm.

Tenasserim: Sukli, 75 km. E. of Moulmein, 600 m., 27-31. x. 1934, R. Malaise (Type).

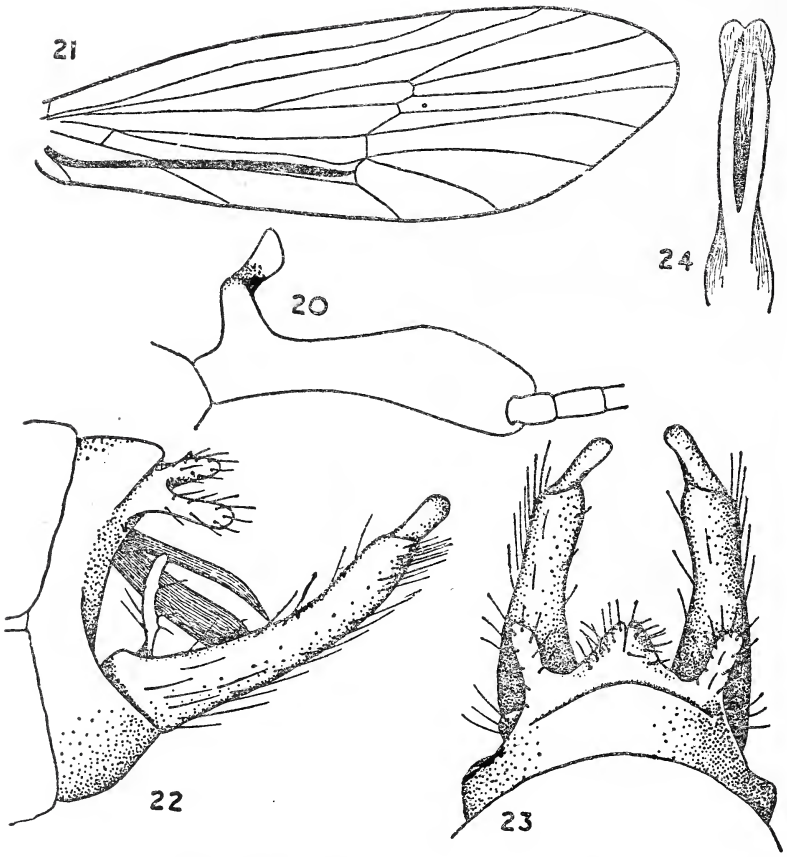
S. Shan States: Road 40 km. E. of Taunggyi, 25. ix—13. x. 1934, ♂ R. Malaise.

Assam: Khasi Hills, McLachlan collection.

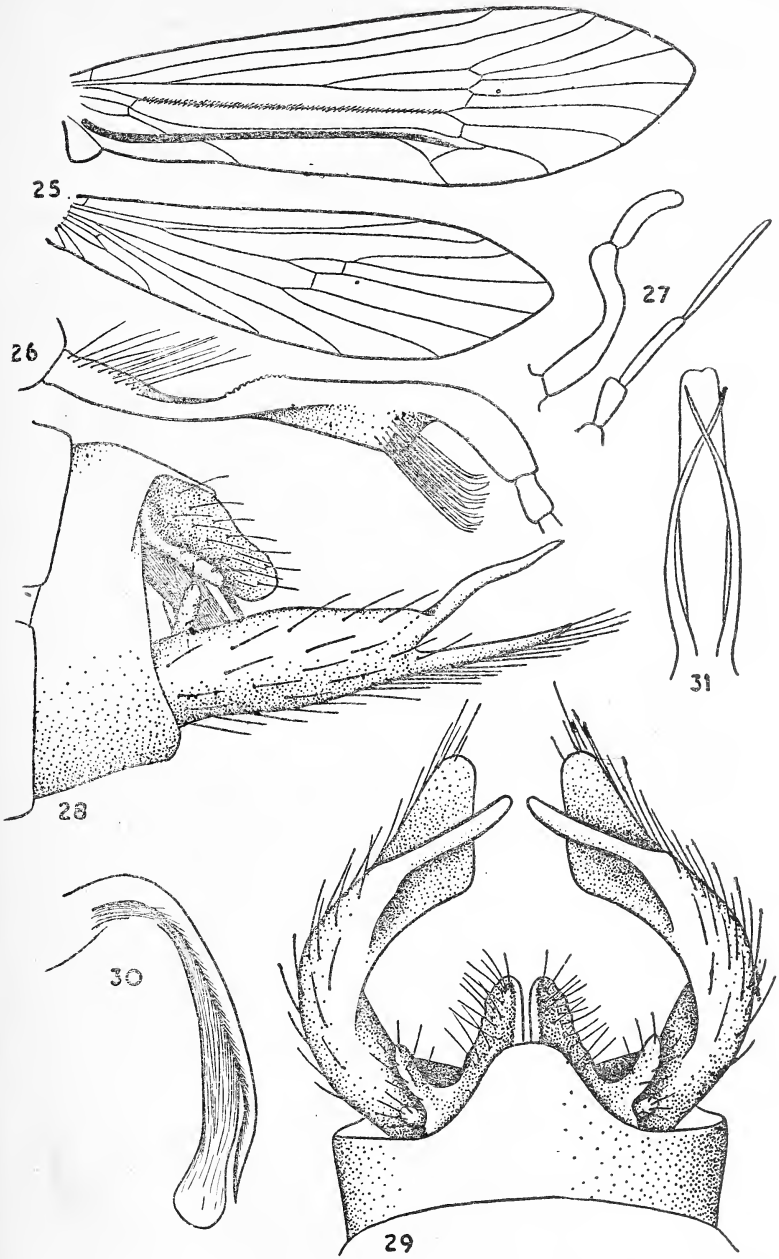
Type in the collection of the Stockholm Museum. Paratypes in the British Museum collection.



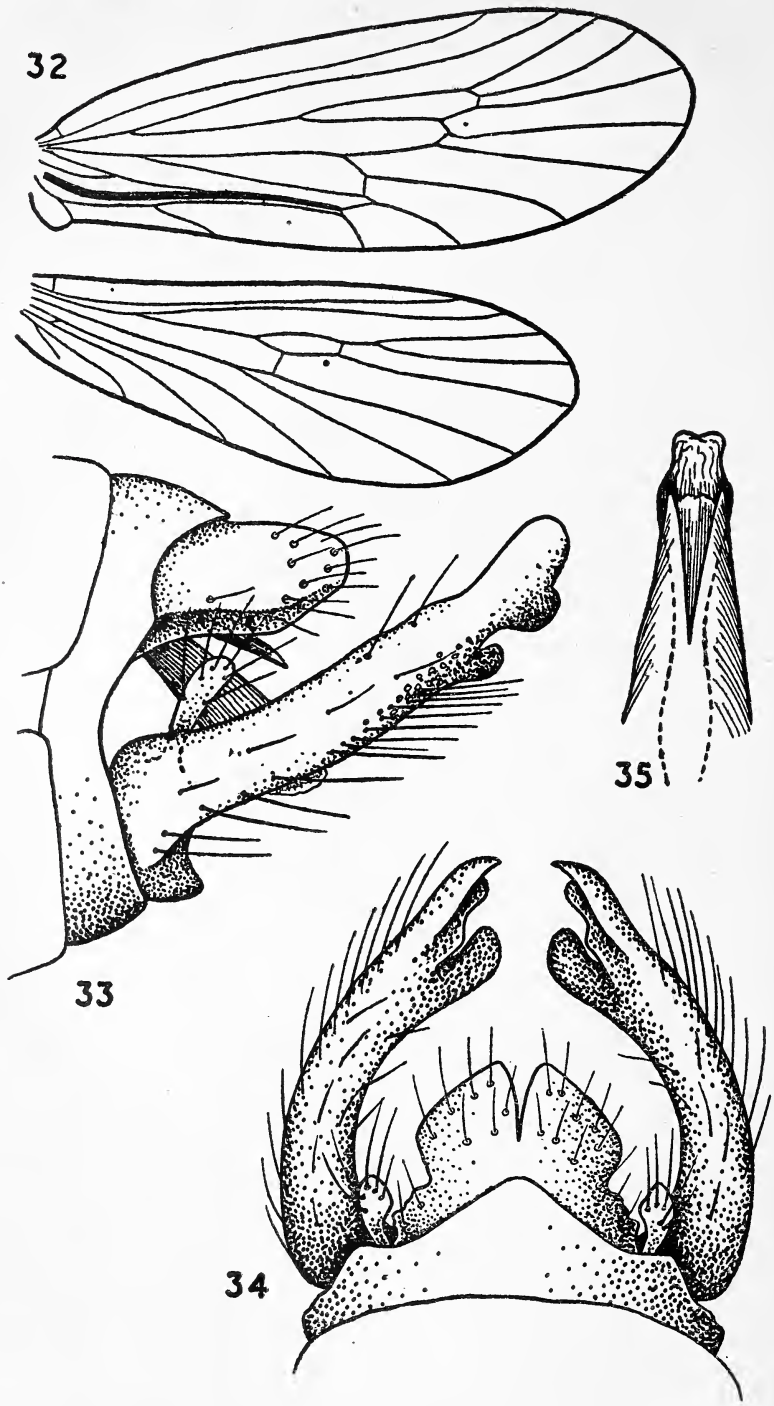
Figs. 14–19. *Adinarthrum moulmina* sp.n. ♂. 14, base of antenna from side. 15, maxillary palpus, lateral. 16, wings. 17, genitalia, lateral. 18, genitalia, dorsal. 19, penis and sheaths, dorsal.



Figs. 20–24. *Adinarthrum taunggya* sp.n. ♂. 20, base of antenna from side. 21, anterior wing. 22, genitalia, lateral. 23, genitalia, dorsal. 24, penis and sheaths, dorsal.



Figs. 25–31. *Agoerodes convolutum* sp.n. ♂. 25, winged. 26, base of antenna from side. 27, maxillary and labial palpi, lateral. 28, genitalia, lateral. 29, genitalia, dorsal. 30, penis and sheaths, lateral. 31, penis and sheaths, dorsal.



Figs. 32–35. *Agoerodes differens* sp.n. ♂. 32, wings. 33, genitalia, lateral. 34, genitalia, dorsal. 35, penis and sheaths, dorsal.

Adinarthrum taunggya sp. n. Figs. 20-24.

Insect dark reddish-brown. In the ♂, basal joint of the antenna comparatively short, dilated towards the apex, basal branch short, stout, with a terminal, semi-transparent plate; wings covered with hairs and scales; in anterior, costa not folded; post-costal fold about half the length of the wing, terminating in a small cellule and with two long, narrow cellules between it and the posterior margin; discoidal cell long, narrow, about as long or slightly longer than its footstalk.

Genitalia ♂—Apical margin of the ninth tergite strongly produced; dorsal plate with the centre produced in a triangle which is narrowly excised at its apex, lateral angles long and slender from the side, longer than the central triangle; penis strongly arched; sheaths slender and parallel; inferior appendages branched and two-jointed, basal branch, which arises from the upper basal margin, slender and directed upward; basal joint long, terminal joint very short.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna 1·2 mm.

S. Shan States: Road 40 km. E. of Taunggyi, 13. x. 1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. This species is very closely related to *A. moulmina*.

Agoerodes gen. n.

Spurs, 2, 4, 4. In the ♂, the basal joint of the antenna varying in length, without processes. Maxillary palpi two-jointed, the proportions and shape of the joints varying in the species. Wings clothed with hairs and scales; post-costal fold varying in length and position; in the anterior, discoidal cell long and narrow, except in *A. sika*. Penis-sheaths present. Inferior appendages furcate at their apices and bearing erect branches at their bases.

Genotype—*A. convolutum* sp. n.

This genus is not very satisfactory and will probably be sub-divided when more knowledge, particularly of the larvae, becomes available.

Agoerodes convolutum sp. n. Figs. 25-31.

Insect brown; wings covered with hairs and scales, the latter long and narrow; anterior, discoidal cell very long and narrow; a groove along the centre of the wing; post-costal fold extending to the anastomosis; distal post-costal cellule broad, the next much the largest; the triangular cellule between the two and the post-costal fold small; posterior wing, fork No. 1 with a short footstalk; basal joint of the antenna very long, somewhat twisted, with large bunches of hair at the base and towards the apex; maxillary palpi two-jointed, basal joint curved, terminal joint rather less than half the length of the basal.

Genitalia ♂—The margin of the ninth dorsal segment strongly produced at its centre; dorsal plate with the centre produced

in a pair of processes separated by an excision, outer angles forming short, curving horns; penis short, sheaths long and slender, apices crossing in the type; inferior appendages single-jointed caliper-shaped, three-branched, basal branch very short and inconspicuous, directed upwards; upper terminal branch, from the side, long, slender and cylindrical, longer than the lower which, from above and beneath, has an enormously dilated, truncate apex.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna 1·56 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 11-v-1934, R. Malaise.

Type ♂ and paratypes ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collection of the British Museum.

Agoerodes differens sp. n. Figs. 32-35.

Insect small and yellowish; in the ♂ basal joint of the antenna about as long as the width of the head with the oculi; maxillary palpi two-jointed, basal joint long and broad from in front, terminal joint very short; anterior wing clothed with hairs and scales, with a short post-costal fold terminating distally in a broad cell, with a still larger cell followed by a small narrow cell towards the base; discoidal cell long and narrow; in the posterior wing, fork no. 1 has a footstalk.

Genitalia ♂—The margin of the ninth tergite is produced and triangular; dorsal plate shield-shaped with a deep, narrow excision at the centre of its apical margin; penis short and down-curved, concealed from above, with a pair of parallel sheaths nearly as long as itself; inferior appendages branched; basal branch arising from the upper margin near the base, directed upward, apex clavate; apex of the appendage bifurcate, the inner fork from above, broad and rounded, the outer claw-shaped, dilated and irregular from the side; from this aspect, there is an angular projection of the lower margin of the appendage at its base.

Length of the anterior wing ♂ 5 mm.

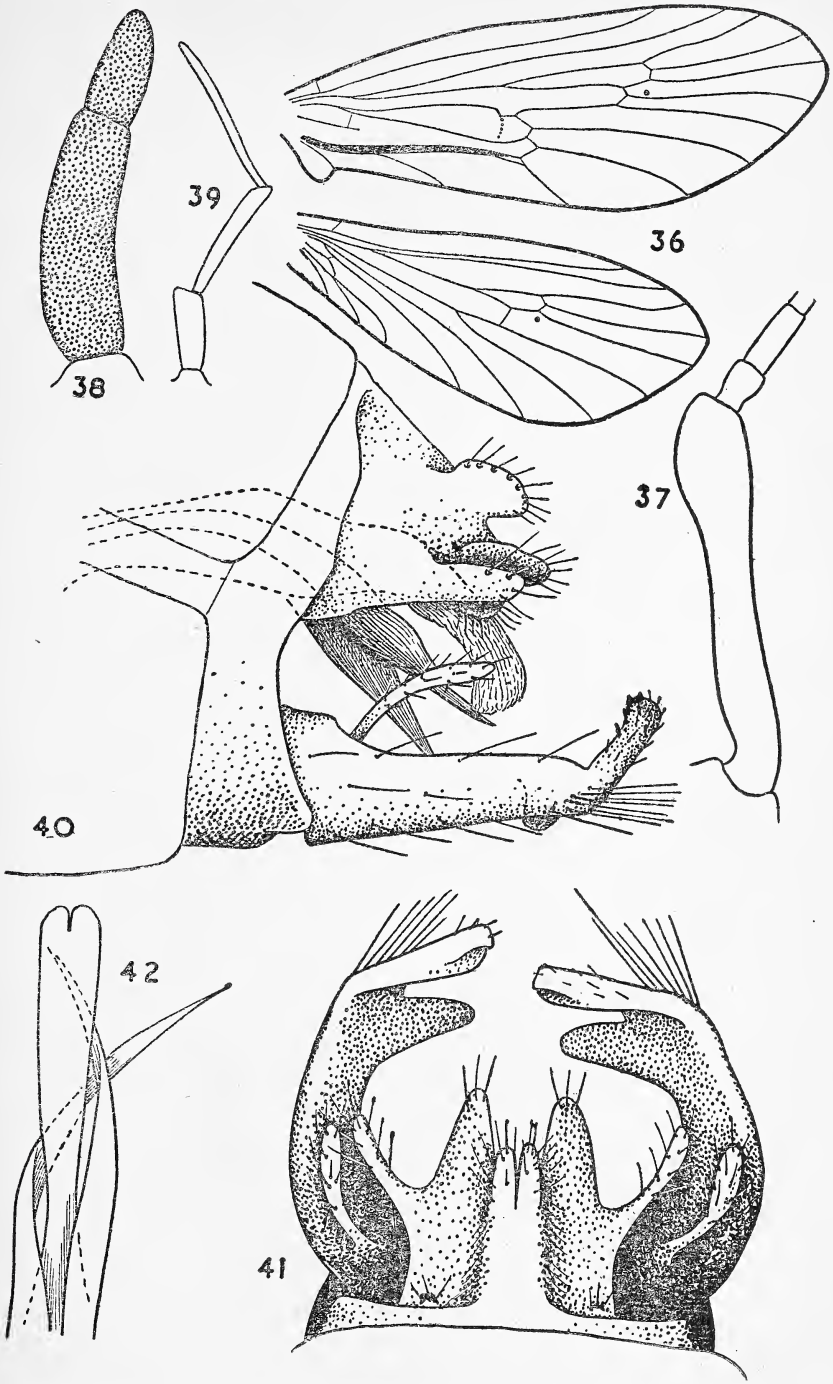
N.-E. Burma: Kambaiti, 23-vi-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

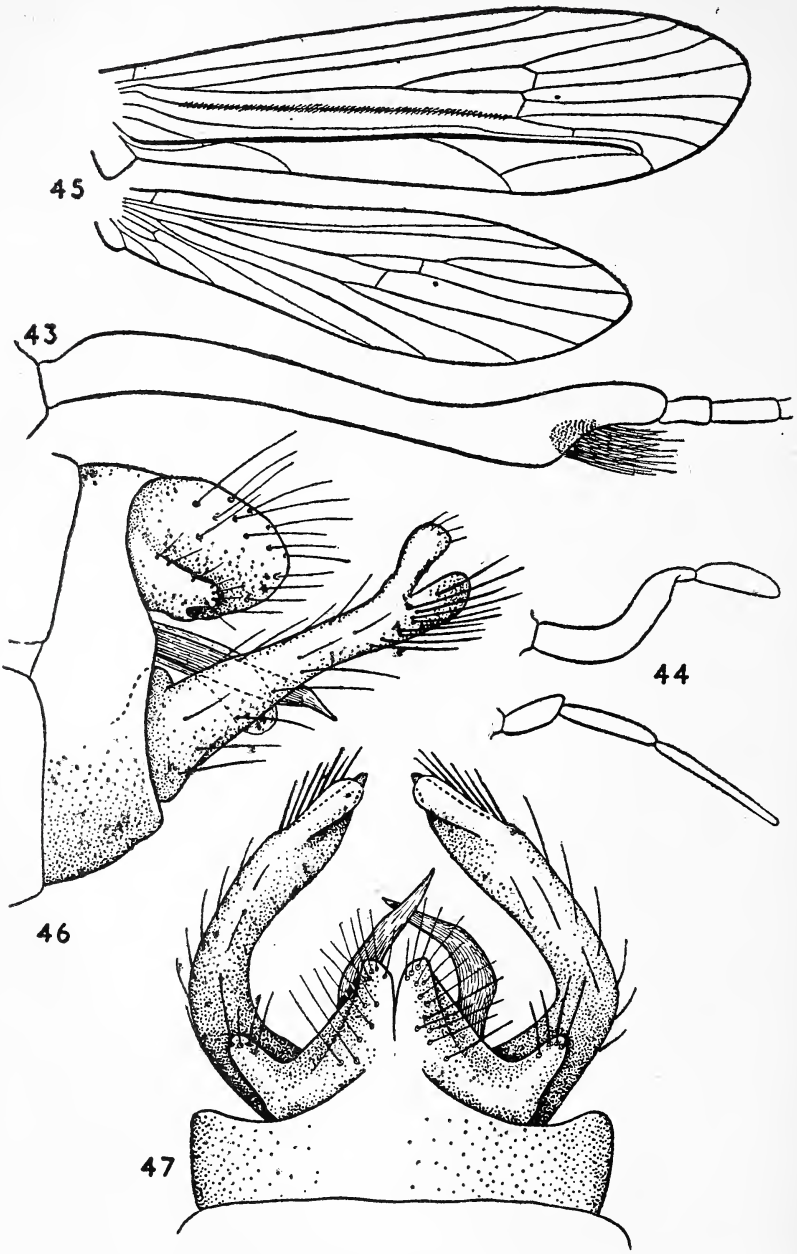
Agoerodes fusca sp. n. Figs. 36-42.

Insect brown; wings broad, covered with hairs and scales; anterior, discoidal cell long and narrow, cellula thyridii wide with a false and broken nervure towards the distal end; post-costal fold rather short, apical cellule No. 7 at which it terminates, large; posterior wing with fork No. 1 sessile; discoidal cell short and rather broad; basal joint of the antenna short, scarcely longer than the head with the oculi; maxillary palpi two-jointed, pigmented dark fuscous, very stout, terminal joint less than half the length of the basal joint.

Genitalia ♂—Dorsal plate displaying three pairs of processes, two at the centre of its apical margin, one pair very short and raised above the lower pair of processes, which are stout and rather widely separated; the third pair forms the produced outer angles of the plate and, from above, are slender and outstretched;



Figs. 36–42. *Agoerodes fusca* sp.n. ♂. 36, wings. 37, base of antenna from above. 38, maxillary palpus from in front. 39, labial palpus, lateral. 40, genitalia, lateral. 41, genitalia, dorsal. 42, penis and sheaths, dorsal.



Figs. 43–47. *Agoerodes malaisei* sp.n. ♂. 43, base of antenna from side. 44, maxillary and labial palpi, lateral. 45, wings. 46, genitalia, lateral. 47, genitalia, dorsal.

penis short; sheaths long and stout from the side, apices acute, crossing each other in the type; inferior appendages single-jointed and three-branched, basal branch slender, directed upwards, second branch short with a truncate apex, arising towards the apex of the third branch which is dilated at its apex.

Length of the anterior wing ♂ 9 mm.

Length of the basal joint of the antenna 1·3 mm.

N.-E. Burma: Kambaiti, 30-iv-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collections of the Stockholm and the British Museums.

Agoerodes malaisei sp. n. Figs. 43-47.

Insects brown in colour; antenna with the basal joint long, slightly curved towards the apex which is dilated, particularly on its under surface, where there is a large cluster of stout brown hairs; there is a large cluster of stout black hairs at the base; maxillary palpi with the basal joint strongly curved, about twice as long as the terminal joint; wings with a clothing of hairs and scales; discoidal cell in both wings long and narrow; anterior with a fringe of long hairs at the base of the costa and with a longitudinal groove along the centre of the wing and a long post-costal fold extending nearly to the apical margin, lined with upright hairs; three large cellules along the posterior border, the middle one the largest, the apical cellule very wide and shallow; all forks sessile; posterior wing, fork No. 1 with a short foot-stalk; fourth apical cellule extending not so far inward as the basal angle of the discoidal cell; one spur of the anterior tibia very small.

Genitalia ♂—Ninth tergite produced in a triangle beyond which is a large dorsal plate, apical margin strongly produced at its centre and excised to make two large, triangular projections, the sides of which are directed downwards so that the plate, as seen from the side, is rather deep; lateral angles produced in short processes; penis short, sheaths symmetrically directed tailward, broad, incurving, narrowing abruptly to acute apices; inferior appendages single-jointed, rather broad, bifurcate at their apices, both forks short, the lower fork wider and shorter than the upper.

Length of the anterior wing ♂ 5·5 mm.

Length of the basal joint of the ♂ antenna 1·70 mm.

N.-E. Burma; Kambaiti, 6,300-7,000 ft., 31-iii., 7, 30-iv., 12-v.-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collections of the Stockholm and the British Museum.

Agoerodes margula sp. n. Figs. 48-53.

Insects brownish. Description of the ♂ : first joint of the antenna very long, with a membranous area before the apex, where the joint is very pliable; maxillary palpi membranous, two-jointed, basal about twice the length of the terminal joint; wings clothed with hairs and scales; anterior, with the costal margin bent over at the extreme base; discoidal cell long and narrow; the post-costal fold somewhat modified and groove-like, certainly more open than

a true fold; it carries a fringe of long hairs directed upward and terminates in three large apical cellules; posterior wings both aberrant, with a small cell enclosing the corneus point below the discoidal cell; fourth apical cellule extending very slightly further inward than the basal angle of the discoidal cell.

Genitalia ♂—Ninth dorsal segment produced at the centre of its apical margin in a large bifurcate dorsal plate, each fork with a large rounded excision of its apical margin, leaving a rather stout, produced, inner angle and a narrow, produced and acute outer angle; immediately beneath the centre of this plate is a pair of short and, from the side, broad penis-sheaths; penis very short and retracted, apex dilated; inferior appendages two-jointed and branched, first joint rather stout, with the inner margin strongly dilated towards the apex where there are two or three very strong spines, two of which are stout and peg-like, the other much finer; terminal joint short; a branch arising from the upper margin near the base is entirely enclosed within the genital capsule and only visible in a balsam preparation; it has the usual slender stem and a somewhat dilated apex; ventral margin of the segment with a broad shallow excision.

Length of the anterior wing ♂ 8·5 mm.

Length of the basal joint of the ♂ antenna 2·75 mm.

Kashmir: Gulmarg, 8,500 ft., 17-24.vii.1923, Fletcher collection.

Type ♂ in the collection of the British Museum.

Agoerodes orientalis sp. n. Figs. 54-59.

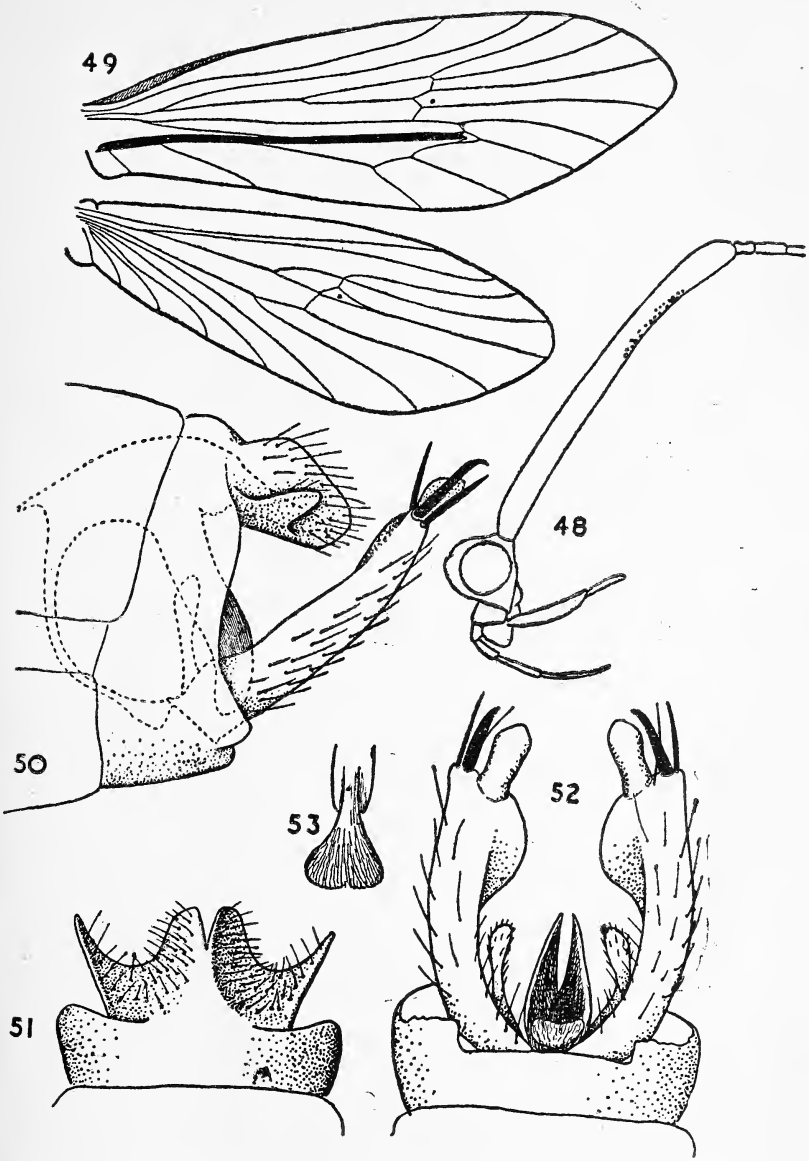
Insect brown; wings clothed with hairs and scales; in the anterior the costal margin is slightly folded; radius thickened in the basal two-thirds; discoidal cell long and narrow; post-costal fold reaching only to the anastomosis; only three conspicuous cellules in the post-costal area, the middle the largest; the triangular cellule between this and the distal cellule minute; in the posterior wing, fork No. 1 sessile; maxillary palpi two-jointed, basal joint from in front, broad, terminal joint small; basal joint of the antenna only slightly longer than the width of the head with the oculi.

Genitalia ♂—Dorsal plate complex; the centre is produced in a pair of processes separated from each other by a well defined excision; these processes are deep, and from the side, the lower margins are seen to extend downward; on each side of these processes, from above, is a short, rounded projection of the margin, while the lateral angles of the plate are produced downwards in long branches with bifurcate apices, varying in shape in individuals; penis short; sheaths long and straight; inferior appendages single-jointed, four-branched; basal branch short, directed upwards, arising from the inner basal margin; second and third branches arising from a stout base, lower branch, from the side, sinuous and nearly twice as long as the upper; fourth branches arising from the ventral margins on the inner sides, long, rod-like and diverging.

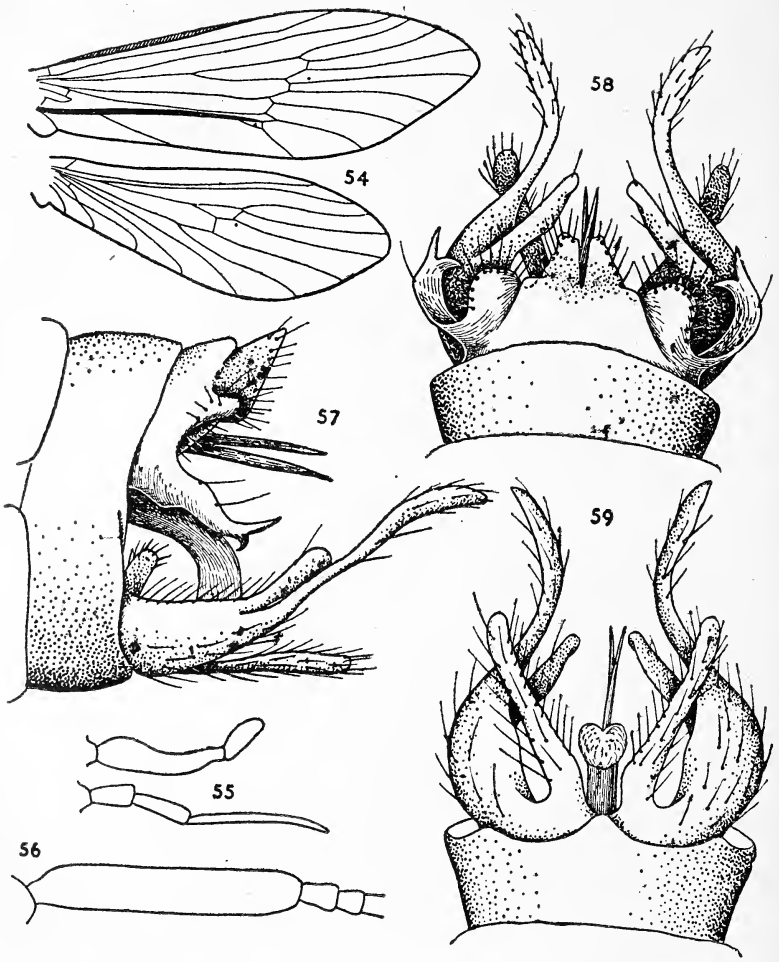
Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna ♂ 1 mm.

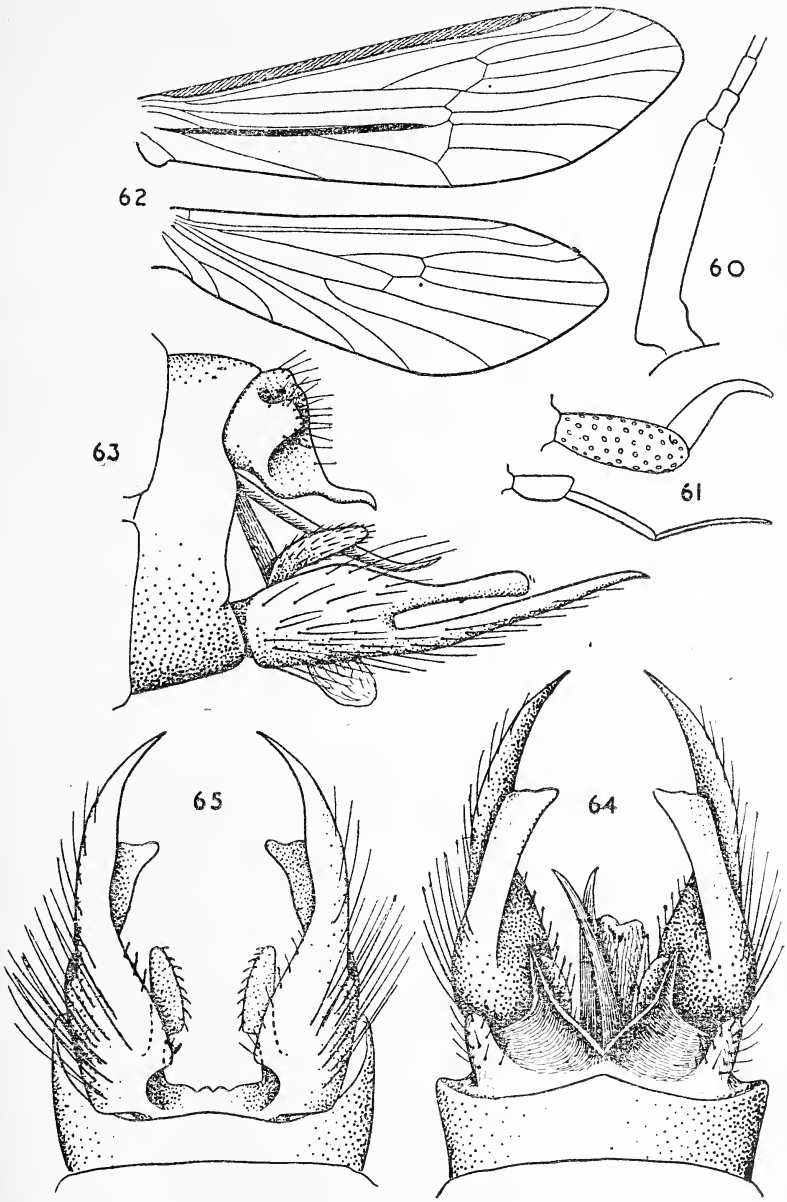
N.-E. Burma: Kambaiti, 30-iv-1934, R. Malaise.



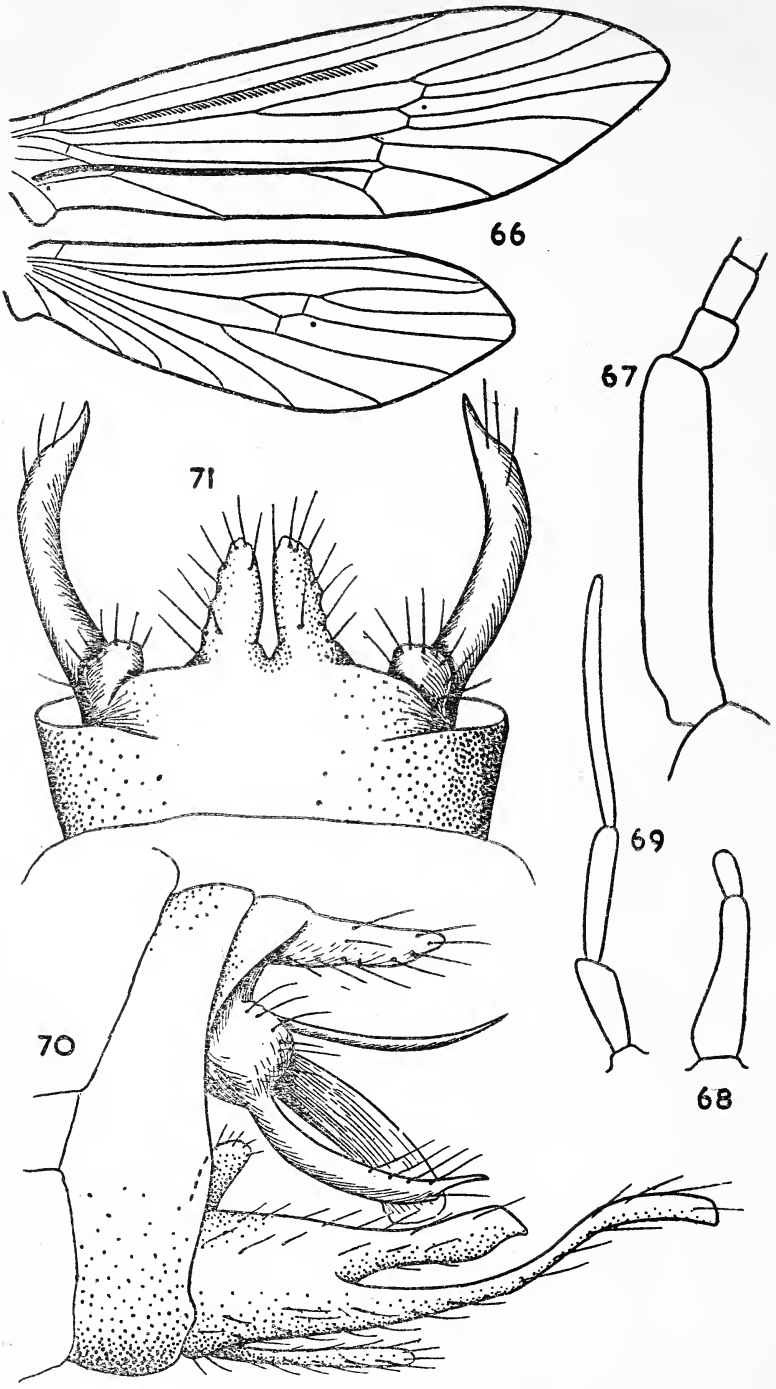
Figs. 48–53. *Agoerodes margula* sp.n. ♂. 48, head, lateral. 49, wings. 50, genitalia, lateral. 51, ninth segment and dorsal plate, dorsal. 52, ninth segment, inferior appendages, penis and sheaths, ventral. 53, apex of penis from behind.



Figs. 54–59. *Agoerodes orientalis* sp.n. ♂. 54, wings. 55, maxillary and labial palpi, lateral. 56, base of antenna from side. 57, genitalia, lateral. 58, genitalia dorsal. 59, genitalia, ventral, dorsal plate omitted.



Figs. 60–65. *Agoerodes sika* sp.n. ♂. 60, base of antenna, lateral. 61, maxillary and labial palpi, lateral. 62, wings. 63, genitalia, lateral. 64, genitalia, dorsal. 65, ninth segment and inferior appendages, ventral.



Figs. 66–71. *Agoerodes simulans* sp.n. ♂. 66, wings. 67, base of antenna, lateral. 68, maxillary palpus from in front. 69, labial palpus, lateral. 70, genitalia, lateral. 71, ninth tergite and dorsal plate, dorsal.

Type and paratypes ♂ in the collection of the Stockholm Museum. Further paratypes ♂ in the collection of the British Museum.

Agoerodes sika sp. n. Figs. 60-65.

Insect brownish. In the ♂, basal joint of the antenna about as long as the head with the oculi; maxillary palpi two-jointed, basal joint broad, terminal joint broad at its base, tapering strongly to its apex; anterior wing clothed with hairs and scales; costa folded over for nearly its entire length; discoidal cell short; post-costal fold situated rather towards the middle of the wing and terminating along the upper margin of a triangular cellule beneath which is a large cellule with a smaller one towards the base of the wing; neuration of the posterior wing regular.

Genitalia ♂—The apical margin of the ninth tergite is produced in a large plate, deeply and widely excised at the centre of its apical margin to leave two, large, triangular projections which, from the side, appear as slender, sinuous processes with hooked apices; outer angles also produced in shorter processes with rounded apices, truncate from the side; penis straight, rather slender, apex dilated; penis sheaths long and asymmetric; inferior appendages three-branched; from above and beneath, the main branch is long, produced to a fine, spine-like apex; second branch shorter, apex obliquely truncate, from the side, separated from the main branch by a deep, parallel-sided excision; third branch arises from a ridge at the base of the appendage at the middle of its upper surface and is short with a very strongly dilated apex, as seen from beneath; from this aspect, the appendages are indented at the bases of their inner margins.

Length of the anterior wing ♂ 9 mm.

Length of the basal joint of the antenna 1·02 mm.

Sikkim: Pucheng, vi. 1896, from the MacLachlan collection.

Type ♂ in the collection of the British Museum.

Agoerodes simulans sp. n. Figs. 66-71.

Insect brown; wings much denuded and now showing scales only on the radius of the anterior; in this wing, discoidal cell long and narrow, slightly shorter than its footstalk; post-costal fold extending to the anastomosis; posterior wing, fork No. 1 with a short footstalk; basal joint of the antenna slightly shorter than the width of the head with the oculi; maxillary palpi two-jointed, basal joint broad, terminal joint small.

Genitalia ♂—Ninth tergite produced in a dorsal plate of which the centre of the apical margin carries a pair of stout, parallel processes, the lateral angles strongly produced in incurving branches with rounded dilatations at the bases and abruptly acute apices; penis short and curved; sheaths stout and parallel, lying above the penis, apices directed upwards away from the penis; inferior appendages single-jointed, four-branched, basal branch arising from the upper margin, short and concealed, directed upwards, second and third branches arising from a stout base and, from the side,

the lower is long and sinuous, nearly twice the length of the upper which terminates in a truncate apex; fourth branches from beneath, arise from the inner margins at the base and are rod-like, widely divergent, inner margins serrate.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna 0·72 mm.

N.-E. Burma: Kambaiti, 6,300 ft., 12-vii-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collections of the Stockholm and the British Museums.

Agoerodes squamosa sp. n. Figs. 72-78.

Insect dark brown, both wings rounded and very densely clothed with hairs and scales, the membrane, when denuded, extremely punctate; anterior with the costa folded over along its basal half; discoidal cell long and narrow; a white line beneath it perhaps indicating a central groove; post-costal fold or groove only faintly indicated, cells between it and the posterior margin narrow; an indication of an obsolete vein in the area below the cellula thyridii; in the posterior wing, fork No. 1 sessile; discoidal cell moderately long; basal joint of the antenna of about the same length as the width of the head with the oculi; maxillary palpi bearing particularly dense tufts of black hair; when denuded, they are seen to be two-jointed, joints flat, basal slightly longer than the terminal and strongly pigmented in a round patch at its base; spurs of the anterior tibiae conspicuous.

Genitalia ♂—The apical margin of the ninth tergite produced in a crown-shaped plate with the middle processes separated by an excision; penis short, arching slightly downwards; sheaths lying above it, parallel with acute apices; inferior appendages single-jointed and three-branched; branch at the base of the upper margin stout, directed upwards; the appendage terminates in a large branch with a broadened apex from above and with a short branch arising from a shoulder on its under surface towards the apex; the whole appendage is covered with very long, stiff bristles arising mainly on the under surface.

Length of the anterior wing ♂ 8 mm.

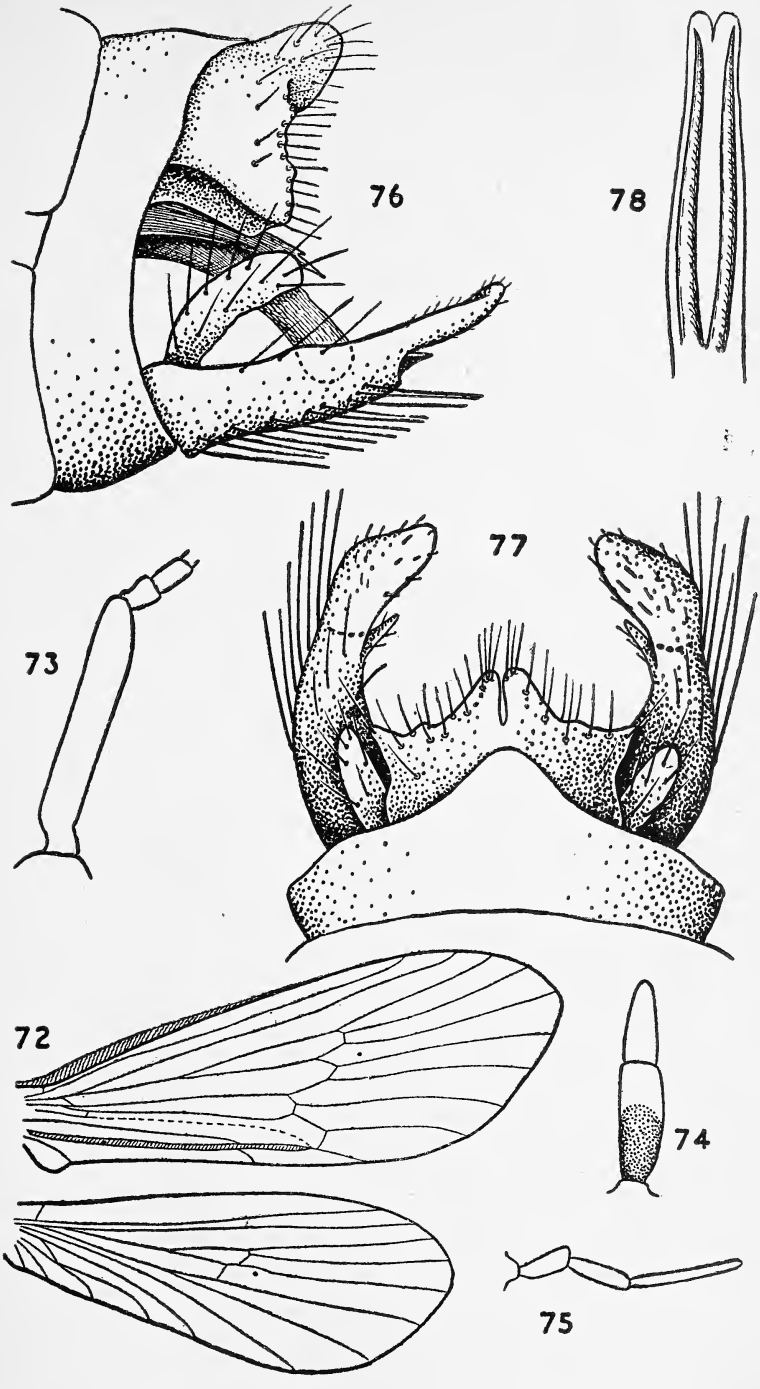
Length of the basal joint of the antenna 1·06 mm.

N.-E. Burma: Kambaiti, 6,500-7,000 ft., 5-iv., 24-v., 12-17-vi., 12-vii-1934, 2,000 m., 15-v-1934, R. Malaise.

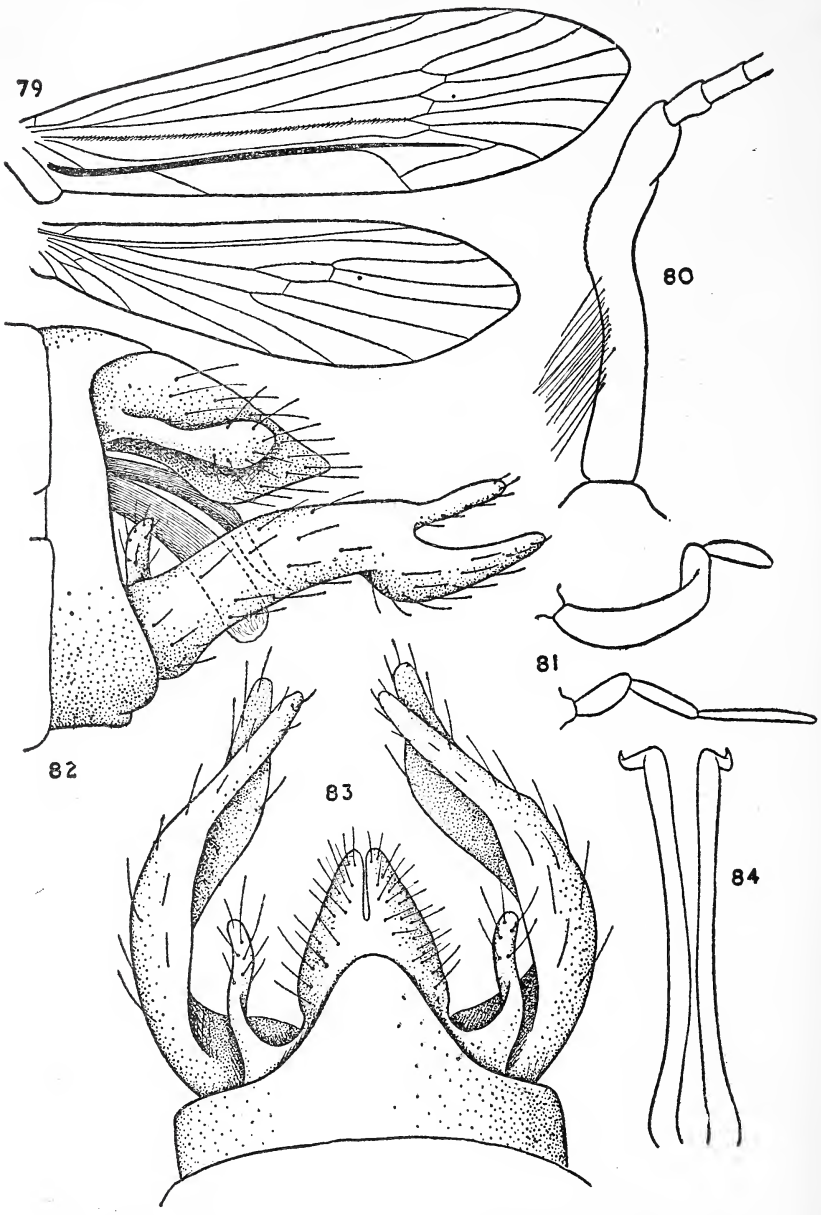
Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collections of the Stockholm and the British Museums.

Agoerodes volutum sp. n. Figs. 79-84.

Insect brown; wings clothed with hairs and scales, the latter long and narrow; anterior, discoidal cell long and narrow; a groove along the centre of the wing; fold in the post-costal area reaching beyond the anastomosis with four large cellules between it and the posterior border; of these, the distal cellule is wide and shallow, the next triangular, the middle cellule by far the largest and the basal cellule about the same size as the distal; posterior, fork No. 1 sessile; basal joint of the antenna about twice as long as the



Figs. 72–78. *Agoerodes squamosa* sp.n. ♂. 72, wings. 73, base of antenna, lateral. 74, maxillary palpus from in front. 75, labial palpus, lateral. 76, genitalia, lateral. 77, genitalia, dorsal. 78, penis and sheaths, dorsal.



Figs. 79–84. *Agoerodes volutum* sp.n. ♂. 79, wings. 80, base of antenna, lateral. 81, maxillary and labial palpi, lateral. 82, genitalia, lateral. 83, genitalia, dorsal. 84, penis sheaths, dorsal.

breadth of the head with the oculi, rather stout and sinuous; maxillary palpi two-jointed, basal joint curved, terminal very short.

Genitalia ♂—The centre of the apical margin of the ninth tergite strongly produced; dorsal plate strongly produced at the centre of its apical margin to form a shield-like projection narrowly excised at its centre, lateral angles produced in long, sinuous processes, apices clavate from the side; penis short, sheaths strongly chitinised and sloping downwards, extreme apices directed abruptly outward; inferior appendages single-jointed, three-branched, basal branch small and concealed, directed upwards, terminal branches nearly equal in length, the lower rather dilated before its apex.

Length of the anterior wing ♂ 6·5 mm.

Length of the basal joint of the antenna 1·32 mm.

N.-E. Burma: Kambaiti, 30-iv-1934, 11-v-1934, R. Malaise.

Type and paratypes ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the collection of the British Museum.

(*To be continued*)

THE NILGIRIS REVISITED

BY

M. A. WYNTER-BLYTH, M.A. (CANTAB.), F.R.E.S.

(With a map and two plates)

The country to the west and south-west of Ootacamund is a high plateau, of which the greater part is untouched by man and remains in its primeval state—a lumpy, uninhabited wilderness of grassy hills and hillocks, clothed here and there with patches of thick forest.

Although I had lived in Ketti for four and a half years, that was during the war and I had had little opportunity of exploring this region—an omission I was determined to make good during my stay in Ooty last spring.

Consequently, in May I planned a short trip that was to take me first to Bangi Tappal and thence via Nanjanad and Hodgson's Hut to Mukerti Peak, a route which would give me a good cross section of the country and could easily be covered in a week.

I arranged for coolies to carry my baggage and food, and was lucky enough to engage a good local servant, so that this year I was fed well and lived in comfort. Don Quixote,[1] who was only a temporary appendage of mine, had been left among his native snows, unmourned but unforgotten.

* * * *

Early on the morning of May 25th we arrived at Ithalar, having covered the first stage of our journey by bus, a perilous undertaking as the heavy rains of the night before had made the newly repaired surface of the road very treacherous. However, although our driver proceeded at great speed, he displayed admirable control of the machine in moments of crisis and we reached our destination unscathed. On arrival at the village we extricated ourselves with difficulty, for the entire population (or so it seemed), stormed into the bus for the return journey to Ooty before anyone had time to descend. In the end we were rescued by some person of authority, and Sheba, myself, and the coolie carrying my bedding, set off across the fields for Bangi Tappal.

The morning was brilliantly fine and humid, promising rain in the afternoon. Indeed clouds were already beginning to form when we reached the Emerald Valley. After crossing the Kundah river the road bears to the left over the lower slopes of the big hill that divides this valley from the next, and begins to descend two miles further on to the ford over the Avalanche stream. Much of the left hand side of the road is planted with *Acacia decurrens*, a mimosa with a pale yellow blossom, that is extensively cultivated

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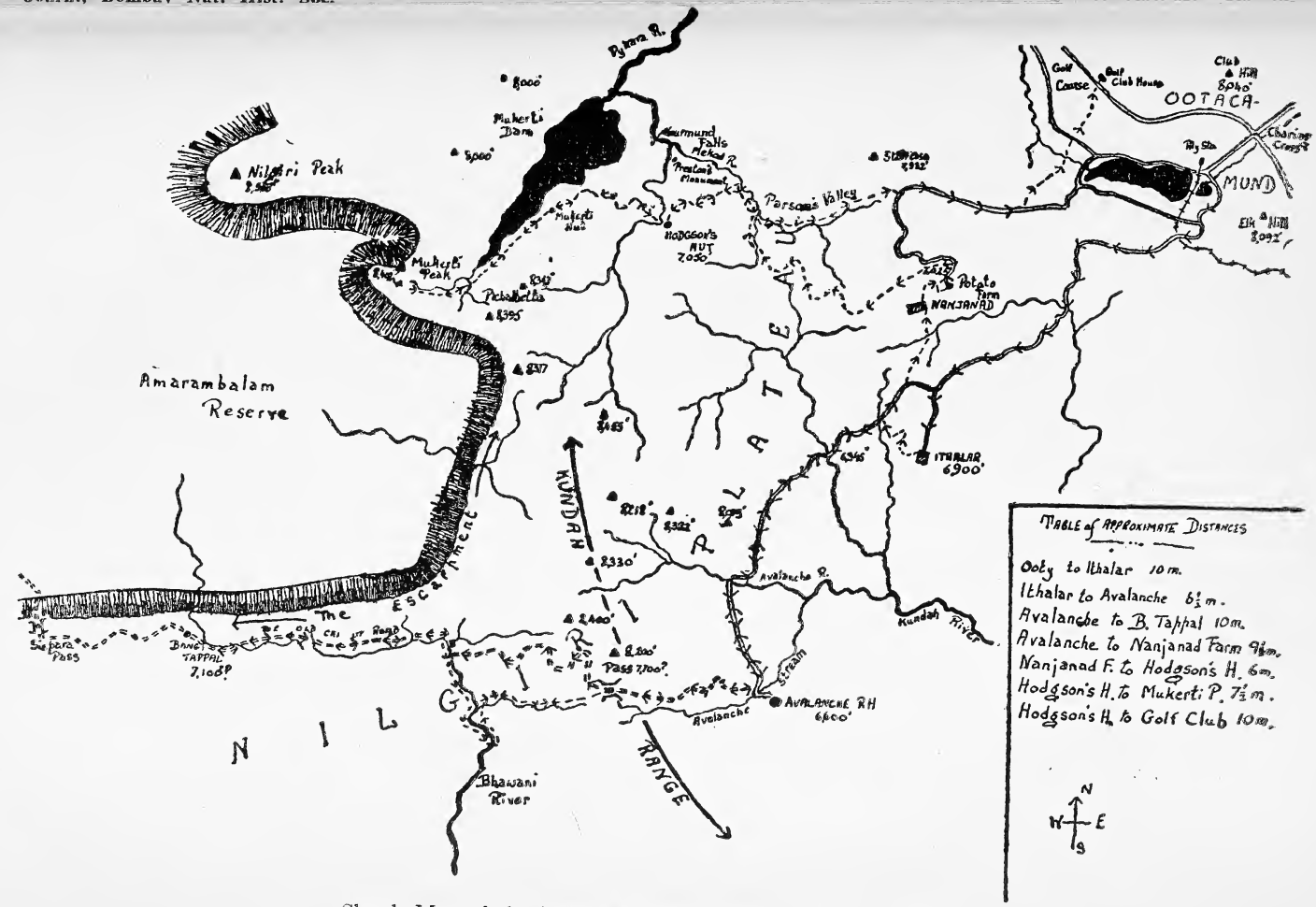
[1] See An Expedition to Sangla in Kunawar in Vol. 47, No. 4, pp. 565-585.



Sketch Map of the Nilgiri Plateau. Scale 1"=about 4 miles.

for its tannin-yielding bark and also as a shade-tree for tea. To the right the hillside is dotted with a thin straggling growth of St. John's wort (1a) and clumps of yellow broom (52). But on the whole there were few flowers, probably because of the prolonged drought earlier in the year. On the other hand this was the only part of the trip where butterflies were at all numerous. Indian cabbage whites (2), red admirals (3), painted ladies (4), Indian fritillaries (5), Nilgiri tigers (6), Nilgiri four-rings (7), and pea-blues (8) were common, together with the occasional hedgeblue and common white albatross (9). Further on I met a congregation of common bluebottle butterflies (10) (an unfortunate name; they bear no resemblance to the bluebottle fly)[1] drinking thirstily from the edges of a small pool, and a red Helen (11), that stately black swallow-tail with the prominent white patch on the hindwing, was hovering about for the same purpose. She is a wary creature and I had to wait patiently for her to group herself with the others so that I could photograph them.

It is only at the foot of the ghats and on the lower slopes of the Nilgiris that butterflies are really abundant. As one climbs, their numbers decrease until on the high plateau they are definitely scarce. This raises an interesting problem, for almost the reverse is true of the Western Himalayas where butterflies are plentiful (subject, of course, to the seasons) to quite 15,000 ft. elevation.

Some of those found on the plateau are of considerable interest as they are palaearctic species that were marooned here in bygone ages. One is led to believe that many years ago there was an era during which the climate of peninsular India was temperate with a fauna and flora to match. With the onset of warmer weather this flora and fauna receded to cooler regions, during which process various insects, plants and animals became isolated on the temperate heights of the southern hills, where they are now in some cases separated by hundreds of miles of hot plains from their nearest relatives. In this category are the Indian cabbage white, the plain hedgeblue (12) and the pale clouded yellow (13) which are also found in the Himalayas, but nowhere nearer. Of the others the red, and blue (14) admirals and the Indian fritillary inhabit most of the Indian hill ranges, but the Nilgiri tiger, the Nilgiri four-ring, the white-disc hedgeblue (15), the white hedgeblue (16), the Palni dart (17) and the red-eye bushbrown (18) are peculiar to the southern uplands.[2]

But this does not explain why there are so few butterflies on the plateau, especially when they are so common lower down. As it is, apart from the palaearctics already mentioned, the majority of butterflies found are tough species such as the peablue and the painted lady, which seem able to exist almost anywhere, and roving, strong-flying insects like the wanderers (*Catopsilia*) which have

[1] So called from the glassy bottle-blue or green band across the wings.

[2] The Annamallais, Palnis and other high ranges to the south of the Nilgiris have two species not found elsewhere—the red-disc bushbrown (*M. oculus*) & the Palni four-ring (*Y. ypthimoides*).

strayed in from lower elevations. The truth of the matter is, I think, that the windswept and rain-drenched plateau with its thick patches of forest is quite unsuited to all butterfly life except the hardiest and the true palaearctics. One can understand that there may well be few of the latter because they are so isolated, and consequently quite beyond the aid of immigration in the case of local disaster.[1]

As I possessed no map that covered this part of the hills I asked the way of the resthouse keeper at Avalanche. Unfortunately he neglected to tell me that he was directing us along a short cut, an omission that was presently to cause disaster.

Avalanche takes its name from an extensive landslide that occurred in this valley during the year 1824. In that year 'for 8 days before the slip occurred there were heavy and continuous rains, accompanied by heavy rolling thunder and a tempestuous wind. So thick, too, was the darkness brooding over that part of the hills, that none of the natives durst venture from their homes. When the gloom cleared away it was found that the river had swept away a vast portion of the mountain side which descended with its woods into the valley'.[2] The traces of this event are now completely obliterated.

So we began the steep climb towards the head of the Avalanche valley and were soon well above the thick forest that borders the stream and finally broadens out to clothe almost the entire region of its source.

These forests, or sholas as they are called in the south, are one of the most characteristic features of the Nilgiris. When seen from above they are a lovely patchwork of grey and shades of green, but their main attraction is the way in which they hug the watercourses and folds of the hills, more often than not in long narrow strips, and give the impression that they have been poured into the valleys and have then congealed, an effect that is enhanced by the uniform height of all the trees and the clear-cut edges of the forest strips. Nilgiri sholas are in effect stream-lined and grow along the valleys and in the folds of the hills not so much because there is water in such places as because they are sheltered from the monsoon gales.

In due course we reached the pass at the head of the valley and paused to look at the view in front of us—green rounded hills, shallow valleys, and an occasional isolated patch of trees—little else but the wind whistling over the grass and a kestrel hovering overhead—a lonely prospect of one of the loneliest parts of India.

Carrying out instructions we took the middle of three paths and followed a charming stream that descends by a chain of little waterfalls and deep pools to join a more considerable river (the

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[1] The curious distribution of the Lepcha bushbrown (*M. lepcha*) seems to me evidence of such a disaster. It is found in the Himalayas, the Central Provinces and Orissa, and the Palnis and Annamallais, but *not* in the Nilgiris.

[2] Murray's Hand-book of India, 1859.

Bhawani) some three miles further on. Here the path vanished and after an hour's fruitless exploration I had to admit that, as far as Bangi Tappal was concerned, we were completely lost. And so there was no alternative but to make our way back to Avalanche. This would mean a night without bedding, as I had lost touch with my coolie, and possibly without food, for I had sent on my supplies to Bangi Tappal the day before, but these hardships were, I felt, better than being benighted in this inhospitable spot and drenched in the thunderstorm that was fast approaching.

As it turned out things were not as bad as I had expected for the storm did not break until we were within a mile of the bungalow, and the resthouse keeper provided us with food—coarse, thick chupatties of home ground wheat with jam, coffee tasting of soup flavoured with treacle, and an excellent egg curry—admirable and sustaining fare for a very tired man and his dog. There was a wood fire to dry ourselves at and my raincoat to keep us warm at night. Life was not so bad after all.

* * * *

Very early next morning we set off again, this time taking a guide to put us on the way. At the head of the valley he set us on the right hand path which, he said, led direct to Bangi Tappal. This track is the old Ooty—Calicut road, which fell into disuse many years ago when the route through Gudalur was opened to wheeled traffic. In the middle of the last century it was second in importance only to the road up the Sigur Ghat[1]—the one road then fit for bullock carts—and was the route used by all travellers from Bombay and the west coast. It is now only a ghost of its former self, for, although here and there roughly paved stretches still remain to show traces of its old importance, much of it has become a mere channel for the monsoon rains or has been engulfed by the swamps that lie in the valleys.

After winding tortuously in and out among the hills it descends to the Bhawani, just a mile above where we had lost ourselves the afternoon before, crosses the river, and runs up a long, rounded almost level valley, bordered on both sides by ranges of low hills.

This is wonderful grazing land, the tussocky grass growing lush and thick, but there were no herds of buffaloes or cattle, neither had I seen any since close to Avalanche. Nearer to Ooty such herds are common but never as abundant as the nature of the country would lead one to expect. Why this is so in such an apparently favoured region is a matter for conjecture. I am told that the periodic droughts of early spring take great toll of the young ones, and that this is the reason why they do not increase. This, how-

[1] 'Travellers coming by the Sigur Pass from Bengalur should send a message to some friend on the hills by electric telegraph so as to ensure supplies at Kilpatti. By this pass communication is kept up with Bengalur, Madras and all places to the north; and the chief bulk of the European supplies and heavy luggage is brought by it to Utakamund.' Murray's Handbook of India, 1859.

ever, does not seem a satisfactory solution, for, even though extensive fires often destroy large tracts of grass, the streams never dry up, and there is always grazing to be had, especially in the many marshy places. Whatever may be the reasons (if, indeed, any exist) against this land supporting large numbers of cattle and buffaloes, there seem to be no grounds for assuming that such reasons should be insuperable, and the fact remains that here are many thousands of unoccupied acres of wonderful grazing land—a fact that the Madras Government might well bear in mind.

At the watershed between east and west India, just beyond where the Bhawani, now a tiny stream, has its source, and where another stream rises to flow westwards, to my intense satisfaction we were met by two of my coolies bearing breakfast. They had been out searching for me until late the night before.

Two miles further on we came at long last to the Bangi Tappal rest house,[1] tucked away into the hillside on the left. Mist was already beginning to pour through a gap in the hills facing the bungalow and shortly after our arrival completely enveloped the valley. When it had partly cleared later on I walked to the gap in the opposite side of the valley and discovered that the little stream ran through this to descend by a series of cataracts into a sinister mist-enshrouded abyss, for Bangi Tappal is at the edge of the Nilgiris and only the low range of hills in front of the bungalow separates it from the precipitous western slopes.

That Bangi Tappal is a place of very heavy rainfall is evident from the rank, coarse grass and the long beards of lichenous moss that festoon the trees. An unidentifiable plant (19) with lanceolate, leathery leaves and pale purple racemes was massed everywhere in the wetter places, self-heal (20)—a handsome, purple labiate—and the slender Nilgiri buttercup (21) were common enough among the grass, but on the whole the place gave the impression of being too bleak and windswept for many flowers.

There, too, and throughout the plateau, there seem to be few birds, but this impression is false, for although the open grassland harbours little but larks (22) and pipits (23), with swallows (24) swooping overhead, and bulbuls (25) and stonechats (26) among the bushes, there are birds enough within the protection of the sholas. In them are found the green woodpecker (27) and the fine Nilgiri woodpigeon (28), small birds that keep to the trees[2] such as flycatchers, white eyes and flowerpeckers, and skulkers like the grey junglefowl (29) and the red spurfowl (30).

Of accomplished songsters there is but one, the Nilgiri blackbird (31), whose liquid notes are little inferior to those of his European counterpart. Another bird whose two calls compel notice

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[1] Which by the way, was as deserted as the countryside. There was no chowkidar and it showed signs of having been unoccupied for a very long time.

[2] Of these the commonest at this time of the year are possibly the Nilgiri flowerpecker (*Dicaeum minullum*), the Nilgiri Blue Flycatcher (*Eumyias albicaudata*), the Black & Orange Flycatcher (*Ochromela nigrorufa*) the Grey headed Flycatcher (*Culiciapa ceylonensis*) and the White-eye (*Zosterops palpebrosa*).

Photo by *Author*

The old Calicut Road
near Bangi Tappal

Hodgson's Hut

Typical Shola formation

Photos by

Author

Hatpin flowers (*Eriocaulon*)

is the Nilgiri laughing thrush (32). Although it is seldom satisfactory to translate the cries of birds into words, these have been fairly adequately rendered as *Pee-ko-ko* and *ko-ko-ko-ko-ko*, both expressed with such a curious jocular accent that they are quite unmistakable, and are among the most characteristic sounds of the Nilgiris. As the bird itself keeps much to the undergrowth it is seldom seen, and more's the pity, for it is a handsome olive brown creature with a very pronounced white eye stripe. Another curious call is that of the grey junglefowl—an awkward, halting, grating *kuk-ka-kurra-kuk* that may be heard around the sholas early in the morning and at dusk.

At Bangi Tappal, as at all the bungalows in which I stayed, as soon as darkness fell, the fireflies (33) began their nightly dance. This has so often been likened to the activities of fairies and elves with lamps and torches and what not, that I shall refrain from simile and content myself with stating that to watch these animated sparks of cold green light on a damp, dull night (the weather they like best) gives me as much pleasure as any spectacle in Nature.

Early next morning I climbed the hill facing the bungalow. The western escarpment of the Nilgiris is very abrupt, dropping vertically from the top for some two thousand feet, and then descending at an acute angle through dense forest to join a belt of jungle at its base. As the hilltop upon which I stood was exactly at the edge of the escarpment it is easy to understand that the view confronting me was very fine, especially as the sun was low and many of the steeper slopes still lay in purple shadow.

The edge of the plateau here runs in a north-easterly direction for perhaps ten miles to beyond Mukerti Peak where it is joined by a shoulder from the west, towards the end of which, quite apart from the main mass of the mountains, and straight in front of the hill I had climbed, is placed the great bulk of Nilgiri Peak. Between and below us lay the jungle-filled bay of the Amarambalam Reserve.

Tradition has it that the Nilgiri Peak (8,500′) has never been climbed and, indeed, is unclimbable, for although it does not appear to present many formidable obstacles, the rock that composes its precipices is supposed to be rotten. My personal opinion is that it would present no difficulty at all to an experienced mountaineer. It is, however, the finest mountain in India south of the Himalayas.

Having gazed our fill we continued on our way. The morning was brilliantly fine and the bright sunshine had brought out such butterflies as there were—of which (to my surprise for it is usually a plains or jungle insect) the commonest of all was the beautiful little dark blue cerulean (34). But the sunshine had also brought out in strength the one real pest of the uplands—the fly in the ointment, so to speak—a horse fly, *Tabanus haematopota,* and never was fly more aptly named.

Elsewhere[1] I have discoursed at length on those two pests of the Simla Hills, a kind of house fly and the large Himalayan horse

[1] See 'An Expedition to Sangla in Kunawar', Vol. 47, No. 4.

fly—the house fly because of its incredible abundance and the horse fly because of its vicious habits. The latter blunders noisily through the air, settles on any exposed piece of flesh, and, an operation that causes considerable pain, plunges its proboscis into the skin and quaffs a great draught of blood. Our Nilgiri tabanid, which is a much smaller species with wings and eyes prettily flecked with brown, eschews such direct methods and gains its objective by stealth. The flight is silent and the bite painless, so that often the only indication that it has been present is a drop of blood on the flesh or the slight irritation set up by the bite.

I had concluded that the females of this fly (for although I have been referring to the species in general terms, the males are inoffensive creatures feeding on honey dew and the juices of flowers) must live a hungry life as there is so little for them to bite in these deserted regions of the plateau, until I discovered that they also have the same habits as the males if they cannot get blood.

As I now knew the lie of the country I took the short cut by the side of the river. The Bhawani here runs through a sheltered valley where there were flowers in plenty. Anemones (35) were everywhere and the grass was dotted with the pale blue bells of *Wahlenbergia* (36) and the deep blue stars of gentians (37). Here and there were small scrubby growths of the yellow jasmine (38), and St. John's wort (16) grew in masses along the river bank. Near the water too, were clumps of both the large and small hatpin flowers (39), so called from their compact white flower heads and long stems.

After following the river bank for a mile we turned up the little valley we had already traversed twice.

* * * *

Just before arriving at Avalanche I came across a young horseshoe viper (40) coiled up on the path. It was a mere six and a half inches long, but in spite of its minute size it displayed a most vicious nature and struck repeatedly at the edge of my butterfly net when I disturbed it. It was a drab-looking little creature of a darkish brown colour with a chain of black blotches down the middle of its back and another smaller one along each side. Its venom differs from that of other vipers in that it causes no swelling around the bite. There is immediate intense pain, followed by a local wet gangrene, which in due course sloughs away. There are no other symptoms, and the bite is seldom, if ever, dangerous.

I saw six other snakes during the trip, of which five were green keelbacks (41) and the sixth an earthsnake (42) that was valiantly trying to swallow a worm of almost its own size. The green keelback, which is very common on the plateau, is a bright green, rather slim snake, of a family that is characterised by a ridge down the middle of each scale. Although, as a rule, keelbacks are found near water, the green keelback is just as common away from it. It also ascends higher than others of the family, and I saw one at 8,400′, just below the summit of Mukerti Peak. On the whole it is a placid snake and does not greatly resent being handled.

A party of Nilgiri langurs (43), much to Sheba's annoyance, had taken up temporary residence in the trees behind the bungalow. Although she displayed every sign of intense displeasure at their presence, it interested me to note that she made no attempt to chase them—a remarkable reversal of her usual behaviour. Possibly this was because, when fully grown, these white-faced black creatures are of a formidable size and aspect, or it may have been due to the alarming noises they produce—a rude chattering which breaks into a deep *whoop* !-*whoop* !-*whoop* ! and resounds through the forest to be heard a mile away.

Close to the river below the rest house I first examined the large, coarse thistles (44) that are so common in the Nilgiri valleys, and found that their heads support quite a remarkable insect population. Ants were there, tiny beetles and spiders, bees, an evil-smelling shield-bug, and in particular a host of weevils. Of these the commonest was the Nilgiri weevil (45), a trim little black creature with five yellow spots on its wing covers and an edging of the same colour to its thorax. Males and females were present in large numbers, each head supporting several, both in the act of mating, which in the weevil family takes place often and lasts for a long time, and crawling in and out among the florets. Doubtless, like the species of the genus *Larinus* of which Fabre has written in his inimitable way, the female deposits her eggs in a little hole she makes for them in the thalamus that supports the florets, and the grubs hatch out and have their being there.

Two other weevils were also present, but in much smaller numbers, one a drab dark brown insect with two obscure paler lines down the wing cases, and the other of a powdery ochreous colour. That I could not identify them is perhaps not surprising as it is estimated that there are possibly 200,000 species of weevil existing at the present day, of which only 60,000 or 70,000 have been described !

I had already noticed in the Himalayas that thistles are particularly attractive to certain butterflies, *Papilio* especially, and there it is no unusual spectacle to see a congregation of them, gorged with honey and half stupefied, hanging from the heads of a single plant. We must not forget too, that the thistle for some obscure reason has been chosen as the national emblem of the Scots—perhaps because it is impossible to sit on either !

There was the usual evening thunderstorm which cleared away as night fell, and the green tree-frogs (46), which are in their hundreds here, began their nightly chorus. Their cry, or call or whatever may be a suitable term for the curious metallic tap-tap-tapping note they produce, is one of the most familiar wet weather sounds of the Nilgiris. Nevertheless it is not surprising that few people connect it with a frog, for a more unfroglike sound is hard to imagine, and the little creatures themselves, though so common, are seldom seen because they are of a vivid green hue that renders them almost invisible among the foliage they inhabit. Their toes are curiously flattened and bear suckers on the undersides to enable them to climb and to hang on to leaves and branches.

The next morning, after our usual early start, we followed the road by which we had first come, until as far as its junction with the Ithalar path, at which point we continued along the Ooty road and two miles further on branched off to Nanjanad at the top of a steep hill.

Nanjanad is a Badaga village and the largest in this part of the Nilgiris. The intense building activity here was eloquent testimony of the period of prosperity through which these cultivators of potatoes are passing. In them skill in agriculture is combined to a truly remarkable degree with an acute money sense.

Beyond the village, over a valley, and stretching up the opposite hillside, is the government potato farm with its small rest house at the far side—in a bleak uninviting spot open to the four winds, but, nevertheless, with a good view down over the farm to the cultivated valley below, remarkable like all the cultivated parts of the Nilgiris for the vivid contrast between the greens of growing crops and the red of the soil.

I did not explore the farm, for, after all, one plot of potatoes is much like another, and the only thing of interest I saw during an evening stroll was an experimental plantation of pyrethrum, in which each row of plants had undergone some different form of cultivation, or treatment, with (apparently) an equal lack of success in all cases. Perhaps the Nilgiris are not the answer to the pyrethrum grower's prayer.

The rest house was in no way remarkable, except for large numbers of flies, but it had a pleasant enclosed verandah which enabled me to watch next morning's dawn over Dodabetta from the comfort of my bed.

There is a lumpy complicated piece of country between the farm and Hodgson's Hut, but as I knew very well the general direction in which to go, by taking such paths as seemed to lead roughly towards my objective, I managed to cross it with a fair measure of success, ultimately joining the path from Ooty only half a mile from the hut.

Hodgson's Hut is charmingly placed near the Krurmund stream in a meadow studded with white anemone (35) flowers. The valley here is narrow but the river broadens out to form a shallow pool in front of the bungalow before taking a sharp turn to the north-west. Above and below the pool the river hastens down the valley among boulders and over stones and small waterfalls after the fashion of mountain streams the world over. Behind the hut is a small shola, and on the one side is a grove of cypress trees: on the other was a mass of *Buddleia* in full bloom.

The hut, although only a small tin building, has comfort and character, and is notable for its remarkable fishing book, in which fishermen have recorded their catches and what is more have drawn them. The illustrations depict many monsters, though, let me add, few of monstrous size.

A mile below the hut, on the edge of an area marked on my map as the Never-Never Land, are the pretty Krurmund falls,

close to which is a stone cairn in memory of one Capt. Preston, M.F.H. of the Ooty Hunt, who was drowned there in the late '80's.

Some of the names on the map[1] are intriguing and redolent of an English country side. For example, between Hodgson's Hut and Ooty lie High Havens, Parson's Valley, Marky's Bog, Andy Corner and Cocky's Course. Close by is Shepherd's Bush, and near Nanjanad Hookham-Snivey! The Never-Never Land is appropriately named as most of it is now submerged beneath the waters of the Mukerti Dam.

On the 29th we set off even earlier than usual to reach the top of Mukerti Peak before it was obscured by clouds.

The path runs up and down, across the line of the small valleys leading to the Mukerti Dam, passing Mukerti Hut after four miles. Thereafter it continues along the side of the lake, though some distance above it.

From here Mukerti (8,402′) has a quaint conical little peak, but when seen from the Mysore road, where the slightly undercut precipice that forms its northern face is in full view, its resemblance to a tooth or fang is quite remarkable. It is a satisfactory mountain to climb, for its ascent, though steep, is not long enough to be exhausting, and the summit holds a very considerable element of surprise.

After climbing for thirty-five minutes we passed through a small wood just below the crags of the pointed peak itself, and here Sheba put up a jackal, disturbing at the same time a group of seven Nilgiri tahr (47) that were standing motionless about fifty yards away. Without undue concern they cantered slowly away over the ridge in front of us.

The Nilgiri tahr or saddleback (often misnamed the Nilgiri ibex) is in appearance a super-goat. For most of the year it keeps to the higher and more lonely parts of the hills, moving about among the rocks and precipices with the usual agility of the goat family, but in spring, during periods of drought, it descends with other game into the lower jungles in search of food. I myself have seen it in early May near Kallar, at an altitude of only 1,350 feet.

Like some of the butterflies already mentioned it was marooned on the southern hills ages ago by a change of climate and now its nearest relative, the Himalayan tahr (48), is found no nearer than the mountains whose name it bears.

As for jackals, they are common enough all over the Nilgiris, even in parts where carrion is very scarce. There they must live largely on frogs and lizards, and, so I'm told, on crabs, for there can be little else for them to eat. Such a diet seems to suit them, as those that I saw were healthy animals with fine coats.

A stiff scramble up a very steep slope ends on the little platform that is the summit. This is perhaps ten yards long and three broad, of which the whole northern side drops vertically into space, how far I cannot say, as a bank of broken cloud

[1] The Ooty Hunt map.

some 1,500′ below us stretched to the north and west as far as the eye could reach. Above the clouds and straight in front the solid mass of the Nilgiri Peak reared itself, to the west there were glimpses of the sea, and behind and below us lay the whole expanse of the very bumpy country between us and Ootacamund.

Murray's Hand-book of India (1859) gives a description of this peak which I cannot refrain from quoting in full. 'From the source of the Paikari (Pykara river) an easy ascent of 1½ mile leads to the summit of the peak; and here, should the mist and clouds fortunately roll away, a grand and awful scene will present itself to the view. The W. (?) side of the mountain is a terrific and perfectly perpendicular precipice of at least 7,000 ft. The mountain seems to have been cut sheer through the centre, leaving not the slightest shelve or ledge between the pinnacle on which the traveller stands and the level of the plains below. To add to the terror of this sublime view, the spot on which the gazer places his feet is a mouldering precipice (!), the ground being so unstable that, with a touch, large masses are hurled down the prodigious height into the barrier forest at the foot of the hills, which looks at such a distance like moss'!

Although the worthy Mr. Murray exaggerates, it was not without relief that I left this somewhat alarming place.

Soon after my return to Hodgson's Hut it was announced to me that a tiger had just killed one of the chowkidar's calves close by. I immediately went with the chowkidar up the hill behind the bungalow to a place above the kill. Three hundred yards away, beyond a small marsh and at the edge of a long shola, stood the tiger looking at us. I watched him for about ten minutes but he did not move, even when I shouted at him and clapped my hands. He seemed on the small size and very pale in colour, but as dusk was falling I could not see clearly. By this time the chowkidar's nostrils were dilating in a startling manner and his eyes were nearly popping out with fright, so we returned to the hut.

At dawn next morning I sent a message over to Mukerti Hut, where a friend of mine, a keen shikari, was staying. I myself visited the kill before breakfast but the tiger had eaten none of it during the night. The chowkidar, whom I persuaded to accompany me again, declared that he saw the beast disappear into a patch of jungle close by, but this I doubted, as by then he was in such a state of alarm that he might well have seen a tiger in every bush. Still, he may have been there, as Sheba, whom I had taken along as a sort of barometer (like taking a canary down a coalmine) began to show distinct signs of unrest. All I saw was a jungle sheep trotting unconcernedly across the hill-side in front.

My friend sat up for the tiger that evening, but without success, for although, according to his shikari, the beast approached within twenty yards of the machan before deciding that all was not as it should be, it was on the concealed side, and he never saw him.

Tigers are not uncommon on the Nilgiri plateau and may be found throughout the year, except when drought drives the game lower down. There were reports of four other tigers during my

stay in Ooty—two at Avalanche, of which one was shot, and a tigress and cub that the hunt surprised one morning at Andy Corner. They are not unknown in Ooty itself and it is not many years ago that one was shot in the garden of West Lake.

Having delayed our start for a while in the hopes that my shikari friend might turn up before we left, we climbed over into Parson's Valley and set off on our return to Ooty.

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At the head of Parson's valley one is back in the country where eucalyptus and other trees introduced from Australia are such a characteristic feature of the landscape. In particular the common eucalyptus or blue gum (49), is planted in great numbers, as it is unsurpassed as firewood and thrives in this climate. In addition, as the tree grows quickly, it may economically be felled after ten years, and coppiced two or three times after that. Eucalyptus oil, which is extracted from the leaves, is a valuable by-product, but gives rise to the pernicious custom of stripping the living trees of their foliage, all the branches being removed except the topmost ones. The result is often picturesque, as a stripped tree develops a tall slender trunk crowned with an attractive tuft of leaves, but the action is indefensible for stripping retards growth by 50%. When allowed to mature unchecked the blue gum is the finest of all Nilgiri trees.

Of other introduced trees the commonest are kinds of cypress and acacia. Of the latter *Acacia dealbata* (the common mimosa that is to be seen everywhere), though its dense heads of bright yellow blossom are attractive, is of no commercial value and is, indeed, something of a pest, for so agreeable does it find the Nilgiri climate, that it often invades fallow land with a thick growth of stunted saplings that is almost impossible to eradicate.

Another common acacia is the Australian blackwood (50), a melancholy species that does not flourish as it is heavily parasitized by various kinds of *Loranthus*. There is, however, one point of interest about this tree, for it is only in its early stages that it bears the typical bipinnate acacia leaves. As it grows older these are replaced by 'phyllodes', or flattenings of the leaf stems, an arrangement to reduce evaporation of sap in the hot sunshine. This arrangement is paralleled in Eucalyptus, whose broad upright primary leaves are later replaced by long narrow hanging secondary leaves, a development which is supposed to be the result of adjustment to a gradual change from a cool to a hot, dry climate in its native land.

Two other hardy and attractive exotics to be seen around Ooty, both of which have been introduced from England, are gorse (51) and broom (52).

Having joined the road that runs from Nanjanad farm to Ooty, we continued along it for a couple of miles before turning to the left along a track that took us over a stream on whose banks grew masses of wild arums, and onto the golf course.

Some mention of the natural history of the Ooty golf course

will perhaps not be out of place, for, of all the Nilgiris except the Ketti Valley, this is the part I know best.

Though from the naturalist's point of view I can record few remarkable events from the course, and no exciting ones, perhaps the incident that took place this year when my opponent killed a Nilgiri skylark (22) in flight with his drive from the 13th tee is unique, and the occasion when a tiger killed three times in one night (or, as an unlikely alternative, three tigers each killed once) is worthy of note. However, tigers on the course (whether feline or human) are very much the exception, as are any other of the larger kinds of game, and the most the early riser can hope to see (apart from jackals) is an occasional wild pig or an even more occasional sambar or jungle sheep. Perhaps after all the wildest forms of life are the players themselves, for they are often very wild indeed.

Nevertheless though larger game may be conspicuously absent, some of the more lowly creatures are not without interest.

On a sunny May morning after a heavy fall of rain the golfer may be surprised to see thousands of large bronzy-brown longicorn beetles (53) blundering about the course in a clumsy way. In the afternoon almost all have gone but the ground is littered with their mutilated remains. Tradition has it (quite wrongly) that a butterfly lives only for a day, but this insect, unless very fortunate, lives (in its final stage) for an even shorter period.

A little observation will show what happens. The crows, of which there is an abundance, devour many of them (and, to the golfer's delight, in so doing lose their appetite for golf balls), but the chief villain of the piece is the Nilgiri tiger beetle (54), a considerably smaller creature with its black wing covers marked with a golden hue. The agility of this insect on the ground and its speed through the air outmanoeuvre its clumsy opponent to such an extent that the latter is completely at its mercy and is often literally vivisected by it. It is no uncommon sight to see one of these longicorns (which, if helpless against their enemies, are at least tenacious of life) walking briskly about though entirely disembowelled.[1]

Because of its transitory existence this beetle must complete the business of reproduction as quickly as possible, so immediately after emergence early in the morning the male seeks the female and they mate. Having done so, the latter goes off to lay her eggs, or oviposit, as entomologists who love ugly words *will* have it. This is a simple speedy business for, moving rapidly from place to place, she uses the spade-shaped end of her abdomen to dig a series of rough holes in the ground, in each of which she places an egg, and this is why these beetles always emerge after heavy rain. If the soil were hard the process of laying would be delayed, or the eggs would have to be left unprotected.

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[1] To quote once more from Murray, 'Black Bear are numerous, especially in the early part of the monsoon when they ascend the hills in pursuit of a large brown beetle, their favourite food'!

Another common beetle that may be seen in May is a beautiful metallic green chafer (55), whose appearance belies its habits, for it works great havoc on our rose bushes.

Of butterflies the golf course has no great abundance though individual species may be common enough, especially the little peablue (8), which can be seen everywhere during most of the year, and the Tamil grass-dart (56), a tiny yellow-spotted brown skipper, which swarms over the grass in April and May. Of rarities I know only one, the plain puffin (57), which (somewhat to my annoyance as a butterfly net is not a usual part of my golfing equipment) I have often seen flying over the course in May, on migration, I think, as its food plant (*Capparis* ?) grows nowhere near.

And for the rest it would be hard to surpass the quiet beauty of these grassy downs with their distant background of high peaks. Along the south-western boundary of the course runs a magnificent avenue of eucalyptus trees, and on the course itself are many patches and strips of yellow-blossomed gorse (51), beloved as a nesting place by the stonechat. Hidden in the grass grow bright blue gentians (37) and pale blue harebells (36), and the tiny little Amaryllis known so aptly as the yellow ground star (58).

We walked up the 17th and 18th fairways to the clubhouse and our journey was at an end.

APPENDIX

A LIST OF SCIENTIFIC NAMES OF SPECIES MENTIONED IN THE TEXT

1a. *Hypericum mysorense* Heyne.
1b. *Hypericum wightianum* Nall.
2. *Pieris canidia canis* Evans.
3. *Vanessa indica pholoe* Fruh.
4. *Vanessa cardui* Linn.
5. *Argynnis hyperbius hybrida* Evans.
6. *Danais nilgiriensis* Moore.
7. *Ypthima chenui* Guer.
8. *Lampides boëticus* Linn.
9. *Appias albina darada* (C. & R. Felder).
10. *Graphium sarpedon teredon* (C. & R. Felder).
11. *Papilio helenus daksha* (Hampson).
12. *Lycaenopsis lavendularis limbata* Moore.
13. *Colias erate nilgiriensis* (C. & R. Felder).
14. *Vanessa canace viridis* Evans.
15. *Lycaenopsis albidisca* Moore.
16. *Lycaenopsis akasa mavisa* Fruh.
17. *Padraona palnia palnia* Evans.
18. *Mycalesis adolphei* Guer.
19. Unidentifiable by *me*. Local experts declare that it is *Swertia decussata* (Gentianaceae).
20. *Brunella vulgaris* Linn.
21. *Ranunculus reniformis* Wallich.
22. *Alauda gulgula australis* (Brooks), The Small Nilgiri Skylark.
23. *Anthus nilgiriensis* Sharpe, The Nilgiri Pipit, and *Anthus richardi rufulus* (Vieill.), The Indian Pipit.
24. *Hirundo javancia domicola* (Jerdon), The Nilgiri House Swallow.
25. *Otocompsa emeria fuscicaudata* (Gould), The Red-whiskered Bulbul.
26. *Saxicola caprata nilgiriensis* Whist. The Nilgiri Stonechat.

27. *Picus xanthopygaeus* (Gray). The Little Scaly-bellied Woodpecker.
28. *Columba elphinstonii* Sykes.
29. *Gallus sonneratii* Temm.
30. *Galloperdix spadicea* ssp.
31. *Turdus merula simillimus* (Jerdon).
32. *Trochalopteron cachinnans cachinnans* (Jerdon).
33. *Lucina* genus. A beetle, of course, belonging to the Lampyridae.
34. *Jamides bochus bochus* Cr., The Dark Cerulean.
35. *Anemone rivularis* Hamilton.
36. *Wahlenbergia gracilis* D.C., The Nilgiri Harebell.
37. *Gentiana quadrifolia* Bl.
38. *Jasminum bignoniaceum* Wall, Golden Trumpet.
39. *Eriocaulon* species. Identification of the genus is difficult. The two mentioned here are probably *E. nilagiriense* Steud. and *E. collinum* Hook. respectively.
40. *Lachesis strigatus.*
41. *Macropisthodon plumbicolor.*
42. *Uropeltidae* sp.
43. *Kasi johnii* (Fisch.).
44. *Cnicus wallichii* D.C.
45. *Baris nilgiriensis.*
46. *Rhacophorus pleurostictus* or *lxalus variabilis.* Probably both.
47. *Hemitragus hylocrius* Blyth.
48. *Hemitragus jemlahicus* H. S.M.
49. *Eucalyptus globulus* Lab.
50. *Acacia melanoxylon* R. Br.
51. *Ulex europeus* Linn.
52. *Cytisus scoparius* Link.
53. *Dorysthenes montanus.*
54. *Cicindela aurofasciata.*
55. *Anomala regina.*
56. *Taractrocera ceramas ceramas* Hew.
57. *Appias indra shiva* Swinhoe.
58. *Curculigo orchioides* Gaertn.

THE BIONOMICS OF RIBBON FISHES (*TRICHIURUS* SPP.) AND THEIR FISHERY ON THE WEST COAST OF MADRAS PROVINCE [1]

BY

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(*With a text figure*)

Regarding the Ribbon fishes (*Trichiurus* spp.) which abound in the inshore regions of Indian waters, Day (2) stated 'Along the coasts of India they are esteemed mostly because being thin and ribbon shaped, they can be dried without salting.' However, these are extensively salt-cured on the West Coast of Madras. They form an economically important fishery on this coast, as can be seen from the table below which shows the ranking of ribbon fishes among the chief fisheries here.[2]

1925–26	11	1935–36	10
1926–27	18	1936–37	9
1927–28	8	1937–38	10
1928–29	22	1938–39	20
1929–30	10	1939–40	8
1930–31	7	1940–41	17
1931–32	13	1941–42	12
1932–33	3	1942–43	9
1933–34	23	1943–44	9
1934–35	18	1944–45	14

Nutritive value :

Recently it has been estimated that the iron content in the ribbon fish, *Trichiurus savala* is 13.89 mgm. per 100 gm., which is the highest among the 29 common food fishes analysed by the technological section of the Madras Fisheries. The fat content is above average, being 3.25% while the phosphorous and calcium contents are 1.51% and 0.47% respectively. These compare very well with those of other fishes. Even though the ribbon fish is not regarded as a prime table fish by the well-to-do, actual analysis has proved its high nutritive value.

The three species, *Trichiurus savala*, *Trichiurus haumela* and *Trichiurus muticus*, constitute the Ribbon fish fishery of the West Coast. Of these, the former two predominate in catches. *Trichiurus muticus* appears only rarely. Each species shoals separately.

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[1] Published with the kind permission of the Director of Industries and Commerce, Madras.

[2] The computation is according to the fisheries year beginning with July and ending with June.

Season of the fishery :

Table showing the landings of the Ribbon fishes on the West Coast for the past ten years in maunds.

Year	July	August	September	October	November	December	January	February	March	April	May	June
1935–36	1,276	38	82	16,869	4,079	3,153	1,973	3,182	13	69	71	242
1936–37	1,022	2,017	18,582	44,039	5,310	33	...	20	346	30	365	...
1937–38	1,783	6,444	7,136	17,797	9,610	...	120	1,560	718	440	413	740
1938–39	5,476	362	...	3,756	..	...	...	...	...	5	839	205
1939–40	4,532	10	19,329	68,050	50	50	15	...	..	45	35	1,388
1940–41	795	...	2,395	...	...	...	...	...	339	10	...	4,078
1941–42	12,770	1,906	1,289	60	...	...	...	...	130	880	8,214	593
1942–43	1,772	5,497	3,195	19,038	2	...	29	423	455	875	5,668	...
1943–44	323	25,970	9,417	15,102	540	...	...	196	10	1,523	1,946	825
1944–45	...	1,550	389	104	...	...	65	50	75	2,180	17,375	368

From the above table it is seen that the fishing season is from April to October. The peak of the fishery is from July to October.

Spawning season :

Of the three hundred and twenty-one specimens of *Trichiurus savala* examined from time to time, ripe specimens were available in the months of April, May and October, while out of the two hundred and fifty specimens of *Trichiurus haumela*, mature specimens were available from February to April and also in October. Whether these two periods constitute two distinct spawning seasons, or one prolonged spawning season, is yet to be confirmed by examining a large number of adult specimens of both the species all through the year. Eggs of Ribbon fishes were obtained from the plankton in the month of October 1939.

In Ribbon fishes, it has been observed that the right ovary and the right testis are much better developed than the left ones. On one occasion a ripe specimen with the right ovary one and a half times more developed than the left was noted. But the ova in both the lobes were equally well developed. Devanesen and John (4) have mentioned the case of *Kowala thoracata* in which the left gonad is better develcped.

Spawning season coincides with the fishing season. This overlapping is likely to have a deleterious effect on the fishery as a whole. Further work is needed to decide the peak of the spawning period of this fish and if this peak is found to coincide with the peak of the fishery, measures may have to be adopted to prevent the depletion of the fishery by enforcing a closed season during the peak period. But the question as to how far the overfishing of this predatory fish, can deplete the fishery as a whole is yet another problem to be solved by the fisheries scientist.

The fluctuation of the Ribbon fish fishery :

The fishery shows a very irregular fluctuation. The overlapping of the fishing season with the spawning season, together with the overfishing of the immature Ribbon fishes as on the East Coast (1) possibly cause these fluctuations. According to Meek (5) hydrographical changes may cause the migration in Ribbon fishes of Cape Town and South Africa, where too, considerable fluctuation in this fishery has been observed. Ribbon fishes being predatory on other economically important fishes, their overfishing can hardly do harm to the fisheries as a whole.

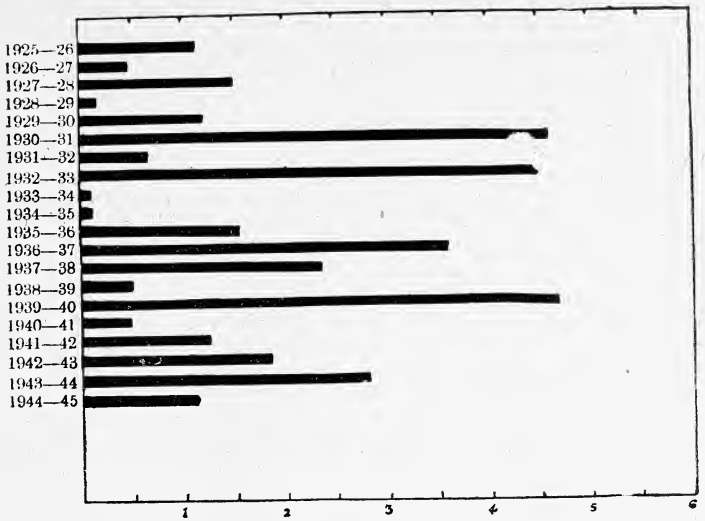

FIG. 1.

Chart showing the landings of Ribbon fish fishery for the years 1925-45, in ten thousands of maunds.

Food of Ribbon fishes :

Venkataraman (6) has recorded the carnivorous feeding habits of Ribbon fishes. According to him Ribbon fishes not only prey upon *Sardinella* spp., the sardines, *Caranx* spp. the horse mackerels, *Leiognathus* spp. the silver bellies, *Cynoglossus semifasciatus* the Malabar soles, *Lactarius lactarius* the Big-jawed Jumper, *Dussumieria hasseltii*, the rainbow sardines, *Ambassis* spp. the glass fishes, *Engraulis* spp. the Anchovies and the *Sciaenids* the Jew fishes, but they are also noticed to swallow fish eggs, thus playing havoc on other fisheries.

The two pairs of large canines in the upper jaw and one pair in the lower, help it to prey on other fishes. The alimentary canal consists of one straight tube without the convolutions met with in herbivorous fishes. Prawns and white-baits form the favourite food of the Ribbon fishes as in the case of Jew fishes and Big-jawed Jumper.

Enemies of Ribbon fishes :

Man who hauls these fishes in millions may be considered to be one of their enemies. These pugnacious creatures are reported to bite fishermen severely and also to destroy nets turning them into shreads with their sharp teeth. Hence only old nets are usually used in the capture of these fishes for fear of spoiling new ones.

It is interesting to observe that these degenerate voracious creatures preying mercilessly on other fishes are not themselves free from the still more voracious sabre-fish *Chirocentrus dorab*. The thread fin, *Polynemus tetradactylus* and Big-jawed Jumper, *Lactarius lactarius* are also known to feed on young Ribbon fishes.

Methods of capture :

The following nets are used to catch Ribbon fishes :—

Seine nets :	*Drift nets* :
Paithu vala	Chala vala
Odam vala	Ozhukku vala
Vakku vala	Kolli vala
Nool vala	Sravu vala
Thalayan vala	

Cast net: Veechu vala.
Shore seine: Rampini net.
Vadakkan vala, vatta vala, sravu vala.

Fishes caught along with Ribbon Fishes :

Prawns, white baits (*Stolephorus* spp.) Oil sardines (*Sardinella longiceps*), Silver bellies (*Leiognathus* spp.) Mackerel (*Rastrelliger kanagurta*), white sardine (*Kowala thoracata*), *Sardinella fimbriata*, Pomfrets (*Stromateus* spp.), Big-jawed Jumper (*Lactarius lactarius*) and the Malabar sole (*Cynoglossus semifasciatus*).

Fishing Centres :

Gangoli, Malpe, Madai, Cannanore, Tellicherry, Badagara, Quilandy, Calicut, Parappanangady, Tanur, Paravanna, Kootayi and Ponnani.

Summary:

From the five hundred and sixty-two specimens of Ribbon fishes examined during the past ten years at the Marine Biological Station, West Hill, and the statistics of fish landed on the West Coast, this note on the bionomics of ribbon fishes and their fishery has been drafted. The rankings of Ribbon fishes among the important fisheries on the West Coast for the past twenty years to 1945 are given, the species constituting the fishery are described, the season of the fishery, their spawning season, the fluctuation of the fishery, the food and the enemies of ribbon fishes are indicated. A chart showing the fluctuation of ribbon fishes is also given.

ACKNOWLEDGMENTS

The data on Ribbon fishes gathered at the Marine Biological Station, West Hill during the past decade by various research workers helped me to draft this note. I am grateful to all of them. But the opinions expressed thereon and the conclusions arrived at are my own. I am also grateful to Dr. H. Sreenivasa Rao, D.Sc., F.A.Sc., F.N.I. and Mr P. I. Chacko, B Sc. (Hons.), F.Z.S. for kindly going through the manuscript and for their valuable suggestions.

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4. Devanesen, D. W. & John, V., 1941: On the Natural History of *Kowala thoracata*. *Rec. Ind. Mus.* Vol 43, p. 216.
5. Meek, A., 1916: The Migration of Fish.—Arnold—p. 331.
6. Venkataraman, R. S., 1944: Food of Ribbon fishes. *Cur. Sc.* Vol. 13, No. 9, p. 239.

A SUPPLEMENTARY LIST OF THE FOOD-PLANTS OF THE INDIAN BOMBYCIDÆ, AGARISTIDÆ AND NOCTUIDÆ

BY

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Since writing the first two papers in this series, *On the Food-plants of Indian Bombyces* (*Heterocera*) (1940, *Journ. Bomb. Nat. Hist. Soc.*, xli, 817–27) and *On the Food plants of Indian Agaristidae and Noctuidae* (1941, *ibid*, 421–30), I have collected a fair amount of further data. Much of this is from Gardner's papers, some from Lefroy's *Indian Insect Life*, and some again from my own observations and from sundry publications.

I have used the same abbreviations as in the original papers with the addition of 'Lefroy' for *Indian Insect Life* and 'Gardner i, ii, etc.' for his papers as under:—

i —1938, *Indian Forest Records*, iii, 187–212.
ii —1941, *Indian Forest Records*, vi, 253–296.
iii—1941, *Indian Forest Records*, vi, 299–309.
iv—1942, *Indian Forest Records*, vii, 155–161.
v —*Indian Journal of Entomology*, v., 89–102.
vi —1946, *Trans. R. ent. Soc. Lond*, 96, 61–72.

ZYGAENIDÆ

PHAUDINÆ

Phauda Wlk.
P. flammans Wlk.—Ficus spp. (Gardner, iv).

CHALCOSIINÆ

Trypanophora Koll.
T. semihyalina Koll.—Rose, Castor, Gardenia, Carissa carandas (mihi), Lagerstrœmia spp., Shorea robusta, Terminalia catappa, T. tomentosa, Barringtonia acutangula (Gardner, iv).

Cyclosia Hbn.
C. papilionaris Drury—Dipterocarpus aporosa, D. tuberculatus (Gardner, iv).

Histia Hbn.
H. rhodope Cr.—Bischofia javanica (Gardner, iv).

Campylotes Westw.
C. histrionicus Westw.—Pieris ovalifolia, Rhododendron sp. (Gardner, iv).

Erasmia Hope.
E. pulchella Hope—Buddleia sp. (Gardner, iv).

Eterusia Hope.
E. pulchella Koll.—Rubus macilentus (Jones, *Journ.*, *Bomb. Nat. Hist. Soc.*, xl, 578). Rubus sp., Melastoma normale, Lagerstrœmia indica, Rose (mihi).
E. aedea L., *cingala* Moore—Tea (Gardner, iv).
E. aedea L., *edocla* Dbl.—Camelia (mihi).

Chalcosia Hbn.
C. pectinicornis L.—Symplocos cratægoides (Gardner, iv).

ZYGAENINÆ

Artona Wlk.
A. discivitta Wlk.—Grasses (Gardner, iv).

Tasema Wlk.
T. bipars Wlk.—Quercus incana (Gardner, iv).

SYNTOMIDÆ

Amata F. (Syntomis O.)
A. cyssea Stoll.—Oats, Convolvulaceæ, Sweet Potato (Lefroy), Dahlia, Cosmos, preferring the flowers (mihi).
A. sperbius F.—Oats, Convolvulaceæ, Sweet Potato (Lefroy).
A. passalis F.—Beans (Lefroy), Dahlia, Orange Cosmos (mihi).

ARCTIIDÆ

NOLINÆ

Nola Leach.
N. distributa Wlk.—Terminalia belerica (Gardner v).
N. fuscibasalis Hamps.—Zizyphus jujuba (mihi).

Roeselia Hbn.
R. fola Swinh.—Terminalia catappa (Lefroy).
R. lignifera Wlk.—Terminalia tomentosa (Gardner, v)

LITHOSIINÆ

Siccia Wlk.
S. taprobanis Wlk.—Lichens on walls (mihi).

HYPSINÆ

Asota Hbn. (Hypsa Hbn).
A. alciphron Cr.—Ficus hispida, F. palmata, Broussonetia papyrifera (Gardner, ii).

Digama Moore.
D. hearseyana Moore—Carissa spinarum (Gardner, ii).

ARCTIINÆ

Diacrisia Hbn.
D. obliqua Wlk.—Heliotropium indicum, Urticaceae spp., Castor (mihi).

Amsacta Wlk.
A. albistriga Wlk.—Groundnuts (Lefroy).
A. moorei Btlr.—Jowar, Maize, Bajra (Trehan & Pingle, *Journ,. Bomb. Nat. Hist. Soc.*, xlvi, 141).
A. lineola F.—Orange Cosmos, Lettuce (mihi).

Creatonotus Hbn.
C. transiens Wlk.—Grasses (mihi).

Pericallia Hbn.
P. ricini F.—Cucurbitaceae (Lefroy), Banana (Trehan & Pingle, *Journ. Bomb., Nat. Hist. Soc.*, xlvi, 153), Impatiens sp. (mihi).

Utetheisa Hbn.
U. pulchella L.—Crotalaria (Lefroy ; Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi 145).
U. lotrix Cr.—Heliotropium indicum (mihi).
U. pulchelloides Hamps.—Tournefortia argentea (Lep. Phal). ssp. *vaga* Jord.—Heliotropium indicum (mihi).

Argina Hbn.
A. cribraria Clerck—Crotalaria (Lefroy).

CALLIMORPHINÆ

Callimorpha Latr.
C. plagiata Wlk.—Ferns, low plants (mihi).

LYMANTRIIDÆ

Dasychira Steph.
D. dalbergiae Moore—Dalbergia latifolia, Eugenia jambolana, Mangifera indica, Shorea robusta, Cassia tora, Ricinus communis (Gardner, i).
D. grotei Moore—Shorea robusta, Tectona grandis, Lagerstroemia flos-reginae. Psidium guava (Gardner, i), Rubus sp., Quercus sp , Polygonum sp., Acacia dealbata, Apple (mihi).

D. pennatula F. (*securis* Hbn.)—Grasses, Crucifers (Lefroy), Grasses (Gardner iii; mihi).
D. mendosa Hbn.—Zea mays, Shorea robusta (Gardner, i), Potato (Lefroy), Sunflower, Castor, Wistaria, Lagerstroemia thorelli (mihi).
D. horsfieldi Saund.—Shorea robusta, Schleichera trijuga (Indian Lac Research Institute Bulletin).
D. tenebrosa Wlk.—Vine, Virginia Creeper (mihi).
D. feminula Hamps.—Vine, Virginia Creeper (mihi).

Orgyia O.
O. postica Wlk.—Lagerstroemia flos-reginae (Gardner, i), Rose, Geranium (mihi).

Laelia Steph.
L. umbrina Moore—Grass (Gardner, i).
L. devestita Wlk.—Grass (Gardner, iii).
L. exclamationis Koll.—Grass (Gardner, iii; mihi).
L. litura Wlk.—Unidentified weeds (Gardner, i).

Leucoma Steph.
L. submarginata Wlk.—Lagerstroemia flos-reginae (mihi).

Caragola Moore.
C. cygna Moore—Cinnamomum camphora, Phoebe lanceolata, Alseodaphne owdenii (Gardner, i).
C. ochripes Moore—Litsaea polyantha, L. sebifera, Phoebe lanceolata (Gardner, i).
C. sericea Moore—Laurineae (mihi).

Redoa Wlk.
R. phrika Collnt.—Shorea robusta (Gardner, i).

Pantana Wlk.
P. bicolor Wlk.—Grass (mihi).

Thiacidas Wlk.
T. vilis Wlk.—Acacia catechu, Prosopis spinigera (Gardner, iii).

Lymantria Hbn.
L. nigra Moore—Mangifera indica (Gardner, i; mihi).
L. semicincta Wlk.—Shorea robusta (Gardner, i).
L. obfuscata Wlk.—Alnus nitidus, Salix babylonica (Gardner, i).
L. mathura Moore—Shorea robusta, Quercus serrata, Terminalia arjuna, T. myriocarpa (Gardner, i).
L. concolor Wlk.—Quercus serrata, Q. incana (Gardner, i).
L. incerta Wlk.—Terminalia myriocarpa (Gardner, iii), Ficus religiosa, Zizyphus jujuba (Lefroy).
L. ampla Wlk.—Terminalia catappa, Ficus religiosa (Lefroy), Castor, Cassia fistula, Lagerstroemia thorelli (mihi).
L. bivittata Moore—Quercus semiserrata (mihi).

Perina Wlk.
P. nuda F.—Ficus glomerata (Gardner, i), Artocarpus integrifolia (mihi).

Porthesia Steph.
P. scintillans Wlk.—Linseed, Hibiscus esculentus, Bajra Mango, Terminalia catappa (Lefroy), Mangifera indica, Ficus glomerata, Shorea robusta, Aesculus indica (Gardner, i), Ricinus communis, Lantana sellowiana, Zizyphus jujuba, Capparis sp., Orange Cosmos, Clerodendron infortunatum, Lagerstroemia thorelli, Kleinhovia hospita (mihi) ssp. *limbata* Btlr.—Melastoma normale (mihi).
P. xanthorrhoea Koll.—Sugarcane, Juar, Bajra, Eleusine corocana, Guinea Grass, other cereals (Lefroy), Weeds (Gardner, i), Lagerstroemia indica (mihi).

Euproctis Hbn.
E. icilia Stoll.—Loranthus (Lefroy).
E. fraterna Moore.—Mangifera indica, Terminalia tomentosa, Shorea robusta, Ricinus communis (Gardner, i), Pomegranate (Caius, *Journ., Bomb. Nat. Hisl. Soc.*, xlii, 26).

E. guttata Wlk.—Maesa indica, Mallotus philippensis, Shorea robusta, Lantana camara (Gardner, i), Zizyphus jujuba, Carissa carandas (mihi).
E. bipartita Moore—Shorea robusta (Gardner, i).
E. inconcisa Wlk.—Melastoma normale (mihi).
E. divisa Wlk.—Rose, Apple, Engelhardtia acerifolia (mihi).
E. digramma Guer.—Melastoma normale (mihi).
E. dana Swinh.—Blumea balsamifera (Lefroy).
E. flavinata Wlk.—Melastoma normale (mihi).
E. bipunctapex Hamps.—Shorea robusta, Terminalia tomentosa, T. myriocarpa, Eugenia jambolana (Gardner, i).
E. sulphurescens Moore —Lantana camara (Gardner, i).
E. lunata Wlk.—Acacia arabica, Zizyphus jujuba, Rosa (Lefroy), Terminalia tomentosa, Cinnamomum camphora (Gardner, i), Carissa carandas (mihi).
E. subfasciata Wlk.—Quisqualis indica (mihi).

THAUMETOPOEIDÆ

Thaumetopoea Hbn.
T. cheela Moore.—Rhus cotinus (Gardner, v).

LASIOCAMPIDÆ

Paralebeda Auriv.
P. plagifera Wlk.—Maesa chisia, Alseodaphne semicarpifolia in captivity (mihi).

Suana Wlk.
S. concolor Wlk.—Shorea robusta (Lefroy), Shorea robusta, Litsaea polyantha (Gardner. iii).

Bhima Moore.
B. undulosa Wlk.—Quercus incana (Gardner, iii).

Taragama Moore.
T. dorsalis Wlk.—Butea frondosa, Zizyphus jujuba (Bulletin Lac Research Institute).
T. siva Lef.—Rose, Zizyphus jujuba, Acacia arabica (Lefroy), Butea frondosa, Zizyphus jujuba (Bulletin Lac Research Institute).

Metanastria Hbn.
M. latipennis Wlk.—Shorea robusta (Gardner, iii).
M. lidderdalii Btlr.—Pine (mihi).
M. hyrtaca Cr.—Eugenia jambos (Aiyar, *Journ., Bomb. Nat. Hist. Soc.*, xliii, 673).

Arguda Moore.
A. bheroba Moore.—Rubus sp., Melastoma normale (mihi).

Chilena Wlk.
C. similis Wlk.—Acacia catechu (Gardner, iii).

Malacosoma Hbn.
M. indica Wlk.—Quercus dilatata (Gardner, iii).

Trabala Wlk.
T. vishnu Lef.—Quercus incana, Terminalia tomentosa, Shorea robusta, Eugenia jambolana (Gardner, iii), Lagerstroemia thorelli (mihi).

Estigena Moore.
E. pardalis Wlk.—Carissa carandas (mihi).

Cosmotriche Hbn.
C. laeta Wlk.—Grasses, Dalbergia sissoo (Gardner, iii).
C. pyriformis Moore —Grasses (mihi).

EUPTEROTIDÆ

Eupterote Hbn.
E. undata Blanch.—Quisqualis indica, Lantana camara, Alseodaphne semicarpifolia, Palms (mihi).
E. geminata Wlk.—Lagerstroemia indica (mihi).

BOMBYCIDÆ

Mustilia Wlk.
M. falcipennis Wlk.—Symplocos sp. (mihi).

Andraca Wlk.
A. bipuncta'a Wlk.—Symplocos sp. (mihi).

DREPANIDÆ

Macrauzata Btlr.
M. fenestraria Moore—Quercus lineata (mihi).

Phalacra Wlk.
P. vidhisara Wlk.—Phoenix sylvestris (Lefroy), Dates (Seitz).

Albara Wlk.
A. argenticeps Warr.—Rubus sp., Quercus lineata (mihi).

SATURNIIDÆ

Actias Hbn.
A. selene Hbn.—Lagerstroemia indica (Parsons, *Journ., Bomb. Nat. Hist. Soc.*, xlii, 209).

Samia Hbn.
S. cynthia Drury—Laurineae sp., Rutaceae spp. (mihi).

Loepa Moore.
L. katinka Westw.—Salix babylonica (Parsons, *Journ., Bom. Nat. Hist. Soc.*, xlii, 209) Impatiens sp., Polygonum sp., Ampelopsis sp. (mihi).

Antheraea Hbn.
A. paphia L.—Shorea robusta, Lagerstroemia indica (Lefroy).

Dictyoploca Jord.
D. simla Westw.—Laurineae sp. (mihi).

NOTODONTIDÆ

Phalera Hbn.
P. sangana Moore, *stigmifera* Btlr.—Erythrina suberosa (Gardner, v).

Gargetta Wlk.
G. costigera Wlk.—Bridelia retusa (Gardner, v).
G. curvaria Hamps.—Bischofia javanica (Gardner, v).
G. ingens Wlk.—Antidesma diandrum (Gardner, v).

Stenadonta Hamps,
S. radialis Gaede—Dendrocalamus hamiltonii (Gardner, v).

Ramesa Wlk.
An unidentified species on Grass (mihi).

Stauropus Germ.
S. alternus Wlk.—Cassia glauca, C. fistula, C. javanica (Gardner, v), Ougeinia dalbergoides (Bulletin Lac Research Institute), Cassia fistula, Ricinus communis (mihi).

Cerura Schrank.
C. liturata Wlk.—Flacourtia cataphracta (Gardner, v).
C. wisei Swinh.—Salix, Populus ciliata (Gardner, v).
C. prasana Moore.—Casearia tomentosa (Gardner, v).

Neopheosia Mats.
N. excurvata Hamps.—Anogeissus latifolia (Gardner, v).

Teleclita Trnr.
T. strigata Moore—Terminalia chebula (Gardner, v).

Notodonta O.
An unidentified species on Bauhinia purpurea (Gardner, v).

Spataloides Mats.
S. argentifera Wlk.—Ougeinia dalbergoides (Gardner, v).

Pygaera O.
P. fulgurita Wlk.—Elaeodendron glaucum, Flacourtia ramontchi, Xylosma longifolium (Gardner, v).
P. restitura Wlk.—Casearia tomentosa (Gardner, v).
P. cupreata Btlr.—Flacourtia ramontchi (Gardner, v).

Gazalina Wlk.
G. apsara Moore.—Quercus dilatata (Gardner, v).

LIMACODIDÆ

Cheromettia Moore.
C. apicata Moore (*laleana* Moore)—Schleichera trijuga (Bulletin Lac Research Institute).

Narosa Wlk.
N. doenia Moore—Castor (mihi).

Altha Wlk.
A. nivea Wlk.—Ricinus communis, Tinospora cordifolia, Orange, Polyalthea longifolia (mihi).
A. melanopsis Strand.—Tea (C.M. Inglis *in litt.*).

Miresa Wlk.
M. albipuncta H.—Schaff.—Butea frondosa (Lefroy).

Mambarilla Herring.
M. narosides Herring—Pear (mihi).

Parasa Moore.
P. lepida Cr.—Palms, Padauk, Lagerstroemia flos-reginae, Cassia fistula (mihi), Castor, Nephelium longana, Terminalia catappa (Lefroy).

Thosea Wlk.
T. loesa Moore—Palms, Carissa carandas (mihi).
T. cana Wlk.—Castor (Lefroy), Cassia fistula (mihi).
T. tripartita Moore—Palas (Lefroy), Zizyphus jujuba, Castor (mihi).

Natada Wlk.
N. suffusa Moore—Castor, Carissa carandas (mihi).

Phocoderma Btlr.
P. velutina Koll.—Mango (Lefroy).

PSYCHIDÆ

Mahasena Moore.
M. graminivora Hamps.—Rice (Lefroy).

Chalia Moore.
C. doubledayi Westw.—Cassia fistula (Lefroy).

Chalioides Hamps.
C. vitrea Hamps.—Mango (Lefroy), Tamarind (Brahmachari *Journ., Bomb. Nat. Hist. Soc.*, xl, 56), Quisqualis indica, Wattle (mihi).

Pteroma Hamps.
P. plagiophleps Hamps.—Tamarind (Brahmachari, *Journ., Bomb. Nat. Hist. Soc.*, xl, 56).

Amatissa Wlk.
A. cuprea Moore—Lagerstroemia indica, Ipomoea palmata (mihi).
A. moorei Heyl.—Lagerstroemia indica (Lefroy).

THYRIDIDÆ

Striglina Guen.
S. scitaria Wlk.—Phaseolus sp. (mihi).

INDARBELIDÆ

Indarbela Fletcher.
Lichi, Bair, Mango, Guava, Orange and other fruit trees (Lefroy).
I. tetraonis Moore—Pomegranate (Caius, *Journ., Bamb. Nat. Hist. Soc.*, xlii, 26), Guava, Mango (Trehan & Pingle, *ibid*, xlvi 151).

COSSIDÆ

Cossus F.
C. cadambae Moore—Teak (Lefroy).

Zeuzera Latr.
Z. coffeae Nietn.—Santalum album (Lefroy).

Xyleutes Hbn.
X. leuconotus Wlk.—In the trunks of Cassia fistula (mihi).

Azygophleps Hamps.
A. scalaris F.—Sesbania grandiflora, S. aegyptica (Lefroy)

AGARISTIDÆ

Aegocera Latr.
A. venulia Cr.—Trianthema, Boerhavia (Gardner, ii).

Seudyra Stretch.
S. venosa Moore—Vitis trifolii (Lefroy).

NOCTUIDÆ

ACRONICTINÆ

Acronicta Treit.
A. pruinosa Guen.—Eleagnus latifolia (Gardner, ii).
A. indica Moore—Plantago sp., Rose, Salvia sp., Melastoma normale, Garden Geranium (mihi).
A. rubiginosa Wlk.—Terminalia myriocarpa (Gardner, ii).

Simyra Treit.
S. conspersa Moore—Lotus (Gardner, vi).

MOMINÆ

Moma Hbn
M. champa Moore—Pyrus communis, Prunus communis (Gardner, ii), Pyrus pashia (Gardner, vi), Rose (mihi).

EUXOINÆ

Rhyacia Hbn.
R. ypsilon Rott.—Tobacco, Potato, Gram (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 146).

HADENINÆ

Polia Treit.
P. consanguis Guen.—Grasses (mihi).

Tiracola Moore.
T. plagiata Wlk.—Polygonum sp., Menispermaceae sp. and a number of unidentified low plants (mihi).

Brithys Hbn.
B. crini F.—Lilies (Lefroy), Zephyranthes sp. (mihi).

Polytela Guen.
P. gloriosae F.—Liliaceae and Amaryllidaceæ, species of Zephyranthes being specially favoured (Gardner, ll).

Hyphilare Hbn.
H. loreyi Dup.—Cereals (Lefroy).

Sideridis Hbn.
S. albistigma Moore—Grasses (Cherian & Anantanarayanan *Journ., Bomb. Nat. Hist. Soc.*, xlii, 611), Paddy (Trehan & Pingle, *ibid*, xlvi, 143).
S. fragilis Btlr.—Wheat (Lefroy).
S. unipuncta Haw.—Rice, Maize, Juar (Lefroy), Sugarcane, Jowar, Maize, Bajra (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi. 140)
S. yu Guen.—Grasses (mihi).
S. venalba Moore—Rice (Lefroy), Grasses (mihi).
S. irregularis Wlk.—Grasses (mihi).

AMPHIPYRINÆ

Stenopterygia Hbn.
S. subcurva Wlk.—Ochna squarrosa (Gardner. ii).

Conservula Grote.
C. indica Moore—Bracken (mihi).

Eriopus Treit.
E. repleta Wlk.—Bracken, ferns (mihi).

Cetola Wlk..
C. dentata Wlk.—Cordia myxa (Gardner, vi).

Prodenia Guen.
P. litura F.—Cotton, Bersin, Lucerne, Maize, Pea-nut, Beet, Sweet Potato. Colocasia, Potato, Leaf Beet, Mallow, Jews Mallow, French Bean, Hibiscus esculentus, Til, Red Pepper, Tomato, Vine, Orange, Plum, Mulberry, Chrysanthemum, Wheat, Rice, Soya Bean, Fenugreek, Egg Plant, Water Melon, Cucurbit, Cabbage, Onion, Mandarin, Guava, Fig, Poplar, Banana, Rose, Mint, Viola, Tobacco, Agathi, Jute, Indigo, Elephant Yam, Pea, Grass, Eugenia malaccensis, Carissa carandas, Moringa pterygosperma, Ficus religiosa, Celery, Cauliflower, Shaddock, Radish, Apple, Pear, Clitorea ternatea, Cestrum nocturnum, Thuya orientalis, Anona squamosa, Papaya, Mango, Glycosmis pentaphylla (Basu, *Journ. Bomb. Nat. Hist. Soc.*, xliv, 278), Tobacco, Cruciferous vegetables, Peas, Banana (Trehan & Pingle, *ibid*, xlvi, 146), Teak (Gardner. ii), Dahlia, Argemone mexicana (mihi).

Spodoptera Guen.
S. mauritia Bsd.—Paddy (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 143).

Laphygma Guen.
L. exigua Hpn.—Jowar, Cotton, Chillies, Cruciferous vegetables, Peas (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 141).

Condica Wlk.
C. indistans Guen.—Weeds (Gardner, ii).

Prospalta Wlk.
P. capensis Guen.—Niger, Jute, Safflower, Coreopsis (Lefroy), Bidens pilosa (Gardner, ii).
P. pallidipennis Warr.—A garden Knapweed (mihi).

Pyrrhia Hbn.
P. umbra Hufn.—Rhododendron arboreum (Gardner, vi).

Elydna Wlk.
E. transversa Wlk.—Schleichera trijuga (Gardner, vi).

Androlymnia Hamps.
A. emarginata Hamps.—Grewia laevigata (Gardner, vi).

Sesamia Guen.
S. inferens Wlk.—Sugarcane, Jowar, Maize, Wheat, Bajra, Paddy (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 141), Grasses (mihi).
S. uniformis Dudg.— Wheat, Sugarcane, Maize, Rice, Juar, Guinea Grass (Lefro).

Chasmina Wlk.
C. tibialis F.—Grewia disperma (Gardner, vi).
C. judicata Wlk.—Helicteres isora (Gardner. vi).

ERASTRIANÆ

Coccidiphaga Spul.
C. scitula Rmbr.—Mealy bugs (Lefroy).

Porphyrinia Hbn.
P. trifasciata Moore—Rivea sp, (Lefroy).

Autoba Wlk.
A. olivacea Wlk.—Solanaceae (Gardner, ii), Brinjal (Lefroy ; Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 147 (mihi).
A. silicula Swinh.—Witches broom on Mangifera indica (Gardner, ii).

Corgatha Wlk.
C. zonalis Wlk.—Lichen on palm trees (mihi).

Hiccoda Moore.
H. dosaroides Moore—Grass (Gardner, ii).

Ozarba Wlk.
O. brunnea Leech—Grass (Gardner, ii).

Amyna Guen.
A. punctum F.—Croton (Lefroy).

Ilattia Wlk.
I. octo Guen.—Sweet Potato (Lefroy), Chenopodium album (Gardner, ii) Amaranthus sp. (mihi).

Berresa Wlk.
B. natalis Wlk.—Sida rhombifolia (Gardner, ii).

Maliattha Wlk.
M. signifera Wlk.—Rice (Lefroy), Grass (Gardner, ii).

Xanthograpta Hamps.
X. *trilatalis* Wlk.—Grass (Gardner, ii).

Naranga Moore.
N. diffusa Wlk.—Rice (Lefroy).

Hoplotarache Hamps.
H. lunana F.—Sida rhombifolia (Gardner, ii).

Tarache Hbn.
T. marmoralis F.—Sida rhombifolia (Gardner, ii ; Lefroy).
T. crocata Guen.—Jute (Lefroy).
T. nitidula F.—Cotton (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.* xlvi, 144).
T. notabilis Wlk.—Cotton, Wild Malvaceae (Lefroy).
T. opalinoides Guen.—Abutilon indicum (Lefroy).

Melicleptriinæ

Chloridea Westw.
C. obsoleta F.—Albizzia procera, Dalbergia sissoo, Lantana, agricultural crops (Gardner, ii), Tur, Gram, Peas (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 150).
Adisura Moore.
A. atkinsoni Moore—Fruits of Hibiscus mutabilis (Gardner, vi).

Euteliane

Bombotelia Hamps.
B. delatrix Guen.—Eugenia jambos (Aiyar, *Journ., Bomb. Nat. Hist. Soc.*, xliii, 673), Eugenia jambolana (mihi).

Chlumetia Wlk.
C. transversa Wlk.—Mango, Litchi (Lefroy), bores in Mango shoots (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 151).

Anigraea Wlk.
A. albomaculata Hamps.—Garuga pinnata, Bursera serrata (Gardner, ii).

Sarrothripinæ

Symitha Wlk.
S. nolalella Wlk.—Lagerstroemia flos-reginae, L. indica (mihi).

Giaura Wlk.
G. sceptica Swinh.—Velvet Beans (Lefroy).

Selepa Moore.
S. celtis Moore—Litchi, Ficus glomerata, Terminalia catappa (Lefroy), Shorea robusta, Terminalia tomentosa, Careya arborea, Eugenia jambolana, etc. (Gardner, ii), Schleichera trijuga (Bulletin Lac Research Institute), Lagerstroemia indica (mihi).

S. docilis Btlr.—Solanum melongena, S. xanthocarpum, S. torvum (Gardner, ii).

S. nephelotis Meyr.—Brinjal (Lefroy).

Barasa Wlk.

B. alopha Hamps.—Terminalia chebula (Gardner, vi) (Gardner considers this species to belong to the Nolinae).

Risoba Moore.

R. basalis Moore—Osbeckia, Melastoma normale (mihi).

R. obstructa Moore—Lagerstroemia flos-reginae (Gardner, ii).

ACONTIINÆ

Earias Hbn.

E fabia Stoll.—Hibiscus esculentus, Cotton (Lefroy).

E. insulana Bsd.—Hibiscus esculentus, Cotton (Lefroy).

E. cupreoviridis Wlk.—Cultivated Hibiscus, Jute (Lefroy), Sida rhombifolia (Gardner, ii).

Pseudelydna Hamps.

P. rufoflava Wlk.—Terminalia tomentosa, T. myriocarpa (Gardner, ii).

Carea Wlk.

C. subtilis Wlk.—Eugenia jambolana (Gardner, ii).

C. nitida Hamps.—Eugenia sp. (mihi).

Maurilia Moschl.

M. iconica Wlk.—Shorea robusta, Tectona grandis, Anogeissus latifolia (Gardner, ii).

Churia Moore.

C. nigrisigna Moore—Grewia laevigata (Gardner, ii).

Westermannia Hbn.

W. coelisigna Hamps.—Terminalia belerica (Gardner, ii).

Acontia O.

A. transversa Guen.—Urena lobata (Gardner, ii).

A. intersepta Guen.—Kydia calycina, Urena lobata, Hibiscus sp. (Gardner, ii).

A. malvae Esp.—Abutilon bidentatum (Gardner, ii).

CATOCALINÆ

Anua Wlk.

A. tirhaca Cr.—Guava (Lefroy).

A. triphaenoides Wlk.—Shorea robusta (Gardner, ii).

Achaea Hbn.

A. janata L.—Ricinus communis (Gardner, ii), Castor, Pomegranate (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 148), Schleichera trijuga, Zizyphus jujuba, Acacia farnesiana (Bulletin Lac Research Institute).

Parallelia Hbn.

P. crameri Moore—Phyllanthus emblica (Gardner, ii).

Attatha Moore.

A. regalis Moore—Ficus religiosa (Gardner, ii).

A. ino Drury—Ficus religiosa (mihi).

Grammodes Guen.

G. geometrica F.—Rice (Lefroy).

Chalciope Hbn.

C. hyppasia Cr.—Leguminosae (Lefroy).

Mocis Hbn.

M. frugalis F.—Rice, Juar, other Gramineae (Lefroy), Grass (Gardner mihi).

M. undata F.—Leguminosae (Lefroy), Rhynchosia minima (mihi)

Pericyma Herr.—Schaff.

P. umbrina Guen.—Acacia catechu (Gardner, ii).

PHYTOMETRINÆ

Phytometra Haw.
P. ni Hbn.—Opium, Cabbage, Safflower (Lefroy).
P. limbirena Guen.—Indigo (Lefroy).
P. tarassota Hamps.—Garden Geranium (mihi).
P. daubei Bsd.—Mint (Lefroy).
P. chalcytes Esp.—Mint, Sann Hemp, Cultivated pulses, Geranium (Lefroy), Lantana aculeata, Solanum pubescens (Gardner, ii).
P. eriosoma Dbl.—Garden Hollyhock (mihi).
P. signata F.—Cabbage (Lefroy).
P. nigrisigna Wlk.—Gram, Lucerne, Peas (Lefroy).
P. orichalcea F.—Crucifers (Lefroy), Dalbergia sissoo, Butea frondosa, Eugenia jambolana (Gardner, ii), Garden Geranium (mihi).

NOCTUINÆ

Cosmophila Bsd.
C. sabulifera Guen.—Jute (Lefroy), Grewia tiliaefolia, G. elastica, G. laevigata, Eriolaena hookeriana (Gardner, ii), Thespesia populnea (mihi).
C. mesogona Wlk.—Rubus lasiocarpus (Gardner, ii), Rubus spp. (mihi).
C. fulvida Guen.—Abutilon avicennae (Lefroy), Kydia calycina (Gardner, ii).
C. erosa Hbn.—Cotton, Sida rhombifolia, Malachra capitata (Lefroy), Urena lobata, Hibiscus esculentus, Cotton (Gardner, ii).
C. indica Guen.—Cotton (Trehan & Pingle, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 144)

Sypna Guen.
S. curvilinea Moore—Rubus sp.
S. latifasciata—Rubus sp.

Ophideres Bsd.
O. fullonica L.—Cocculus laurifolia (Gardner, ii).

Adris Moore.
A. tyrannus Guen.—Menispermaceae sp. (mihi).

Pandesma Guen.
P. quenavadi Guen.—Acacia catechu (Gardner, ii).

Polydesma Bsd.
P. umbricola Bsd.—Albizzia stipulata (mihi).

Ericeia Wlk.
E. inangulata Guen.—Cassia fistula (mihi).

Catephia O.
C. inquieta Wlk.—Sweet Potato (Lefroy).

Sphingomorpha Cr.
S. chlorea Cr.—Acacia (Lefroy).

Fodina Guen.
F. stola Guen.—Holarrhena antidysenterica (Gardner, ii).

Azazia Wlk.
A. rubricans Bsd.—Leguminosae (Lefroy).

Episparis Wlk.
E. tortuosalis Moore—Chukrassia tabularis (Gardner, ii).

Hypocala Guen.
H. rostrata F.—Diospyros montana, D. melanura (Gardner, ii).

Plecoptera Guen.
P. reflexa Guen.—Dalbergia sissoo (Gardner, ii).

Oraesia Guen.
O. emarginata F.—Cissampelos pareira (Gardner, ii).

Boccula.
B. hypenoides Moore—Grewia disperma (Gardner, vi).

Sympis Guen.
S. rufibasis Guen.—Litchi (Lefroy).

Pasipeda Wlk.
P. haemorrhoa Guen.—Barleria cristata (Gardner, ii).

HYPENINÆ

Raparna Moore.
R. nebulosa Moore—Indigo (Lefroy).

Simplicia Guen.
S. robustalis Guen.—Dry leaves of Dalbergia sissoo (Lefroy).

Dichromia Guen.
D. orosia Cr.—Tylophora hirsuta (Gardner, vi).
D. quadralis Wlk.—Boehmeria sp. (mihi).
D. trigonalis Guen.—Boehmeria platyphylla (Gardner, vi).

Rhynchina Guen.
R. abducalis Wlk.—Ougeinia dalbergoides (Gardner, vi).

Hypena Schrank.
H. proboscidalis L., *indicalis* Guen.—Girardinia heterophylla (Gardner, vi)
H. iconicalis Wlk.—Desmodium gangeticum (Gardner, ii), Butea frondosa (Gardner, vi).
H. rectivittalis Moore—Desmodium gangeticum (Gardner, vi).
H. conscitalis Wlk.—Desmodium gangeticum (Gardner, vi).
H. ignotalis Wlk.—Lantana aculeata (Gardner, ii), Lantana camara (Gardner, vi).
H. uniformis Hamps.—Indigofera pulchella (Gardner, vi).
H. sublividalis Snell.—Desmodium gangeticum (Gardner, vi).
H. aurotincta Hamps.—Abrus precatorius (Gardner, ii).

Bomolocha Hbn.
B. occata Moore—Boehmeria platyphylla (Gardner, vi).
B. triangularis Moore—Boehmeria platyphylla (Gardner, vi)

HYBLAEINÆ

Hyblaea.
H. puera Cr.—Tectona grandis (Lefroy).
H. constellata Guen.—Tectona grandis (Lefroy).

ARTIFICIAL KEY TO THE PAPILIONACEÆ OF BOMBAY PROVINCE

BY

H. SANTAPAU, S.J.

The following is an artificial key covering one of the most difficult groups of Bombay plants ; the system followed here is the same as that of the ' Artificial Key to the Compositae of Bombay Presidency ' published in the first number of the *Indian Ecologist*, in April 1946.

This key is primarily based on the colour and other obvious characters of the plants in question. Colour is not an important feature of the flower for the serious taxonomist ; but experience with botany students has convinced me that colours are readily distinguished even by beginners and can, therefore, be of considerable help in tracing at least the genus of a given plant.

As to the method of using this key, the first step is to try and trace the colour of the flower. For this purpose it is important that fresh flowers be employed, that is to say, flowers which are fully open and have not yet withered. It often happens that of the flowers on a given spike or raceme, the uppermost are still in bud or at least are not yet fully expanded, whilst the lowest may be already wilting. In both cases, that is to say, with very old or with very young flowers, the colours are often considerably distorted as compared with those of the flowers about the middle of the spike or raceme. This is particularly the case with plants with pink or blue or lilac flowers, such as those belonging to the genera *Desmodium*, *Alysicarpus*, etc.

Once the colour of the flower has been ascertained, consult the key, and make sure of examining *all* the alternatives in the key ; see the lines or paragraphs headed by the same number, they are all alternative among themselves.

A particular genus may come under various headings ; this means that some species of the said genus have flowers of one colour, whilst other species of the same genus may have flowers of quite a different colour.

A possible source of doubt may be that on one and the same flower there may be more than one colour. In such cases take the most prominent colour as typical of the plant. If there are variations in the colour of the petals, take that of the standard as the proper colour of the flower, and if the inner and outer colours differ, take that of the inner surface of the standard as the correct one. If, however, the standard is missing or is inconspicuous, make use of the colour of the wings for the identification of the plant.

After the colours, attention is to be paid to the arrangement of the stamens in the flower ; in examining the stamens, however, care must be taken, or the free stamen or stamens may be damaged in the process. In general the stamens are grouped according to three clear patterns : (*a*) Stamens 5+5, that is to say, the androecium is divided into two sections, each of 5 stamens with filaments partly united at the base. (*b*) Stamens 9+1, the lower 9 stamens having their filaments united partly from the base, the upper stamen being free or nearly so for its whole length. (*c*) Stamens 10 or fewer, but not definitely arranged according to the two previous groups.

For the rest this key is meant to cover most of the genera as given by Cooke. Two genera are excluded, *Stylosanthes* and *Eleiotis* ; I have been unable to see any living specimen of these two genera or find any precise reference to the colour of these plants. No account has been taken in the preparation of this key of any paper or book published after Cooke's Flora ; the latter is the standard book among students in Bombay and for practical purposes is the most complete work on the flora of this Province.

As in the case of the previous key, the present one is published with the hope that it may be useful to students and others interested in the very large Pea-flower family. Corrections and suggestions will be gratefully received by the author.

1. *Flowers white* :
   2. Stamens 5+5 ... *Dalbergia.*
   2. Stamens less than 5 :
      3. Trees or large scandent shrubs ... *Dalbergia.*
      3. Slender, herbaceous climbers ... *Abrus.*

2. Stamens 10, connate or free, but not 9 + 1 :

4. Trees :
5. Pods winged along sutures ... *Derris.*
5. Pods not winged ;
6. Pods thin, flat & oblong, not woody ... *Dalbergia.*
6. Pods woody, obliquely oblong ... *Pongamia.*
4. Erect shrubs or undershrubs ... *Desmodium.*

4. Herbs :
7. Twiners or climbers ... *Clitoria.*
7. Erect herbs ... *Crotalaria.*
7. Small, trailing herbs (sometimes prostrate or diffuse ... *Desmodium.*

4. Climbing shrubs :
8. Pods few-seeded, up to 7·5 cms. long :
9. Leaflets distinctly alternate ... *Dalbergia.*
9. Leaflets opposite ... *Derris.*
8. Pods many-seeded (more than 4 seeds), over 7·5 cms. long :
10. Style bearded below the stigma ... *Clitoria.*
10. Style not bearded below the stigma :
11. Leaflets 11–15 ... *Milletia.*
12. Leaflets 3–6 ... *Canavallia.*

2. Stamens 10, diadelphous (i.e. 9+1)
12. Trees :
13. Leaves trifoliate ... *Ougenia*
13. Leaves 5–9-foliate ... *Pongamia*

12. Erect shrubs or undershrubs :
14. Bracts large, 12—24 mm. long, usually broader than long ... *Flemingia.*
14. Bracts small and narrower than long ... *Desmodium.*

12. Climbing shrubs:
15. Leaflets 3 ... *Cylista.*
15. Leaflets 5—9 ... *Derris.*
15. Leaflets 11—15 ... *Milletia.*

12. Herbs:
16. Erect ... *Mellilotus*
16. Trailing or prostrate ... *Desmodium.*
16. Climbing or twining ... *Clitoria.*

1. *Flowers orange or salmon-coloured* ... *Butea.*

1. *Flowers yellow*:
17. Stamens 9, or at least less than 10 ... *Dalbergia.*
17. Stamens in two bundles of 5 each (i.e. 5+5) :
18. Trees ... *Pterocarpus.*
18. Herbs or small shrubs:
19. Pods variously twisted, enclosed in calyx ... *Smithia.*
19. Pods straight, exerted from calyx ... *Aeschynomene.*
17. Stamens 10, connate or free, but not 9+1:
20. Large trees ... *Pterocarpus.*
20. Large, woody climbers ... *Milletia.*
20. Erect shrubs or undershrubs:
21. Leaflets 15—15 ... *Sophora*

21. Leaflets 1—7 :
    22. Seed 1 : leaves trifoliate ... *Psoralea.*
    22. Seeds usually many ; when seed only 1, leaves often simple ... *Crotalaria.*

20. Herbs (erect, prostrate or climbing) :
    23. Anthers uniform :
        24. Leaflets 4 ... *Geissaspis.*
        24. Leaflets 3 ... *Rothia.*
    23. Anthers dimorphous :
        25. Leaves 2-foliate ... *Zornia.*
        25. Leaves not 2-foliate :
            26. Pods flattened ... *Heylandia.*
            26. Pods turgid ... *Crotalaria.*

17. Stamens diadelphous, i.e. 9 + 1 ;
    27. Climbing shrubs :
        28. Leaves gland-dotted beneath :
            29. Seeds 3 or more :
                30. Corolla up to 18 mm. long ; pods with deep lines between the seeds.... *Atylosia.*
                30. Corolla 25 mm. or longer ; pods with faint lines between the seeds ... *Dumbaria.*
            29. Seeds 1—2 :
                31. Calyx teeth accrescent ... *Cylista.*
                31. Calyx teeth not accrescent ... *Rhynchosia.*
        28. Leaves not gland-dotted beneath :
            32. Leaflets 11—15 ... *Milletia,*
            32. Leaflets 4—5 ... *Mucuna.*
    27. Erect shrubs or undershrubs :
        33. Leaflets 7—11 ... *Indigofera.*
        33. Leaflets 15—50 ... *Sesbania.*
        33. Leaflets 3 :
            34. Seeds 8—10 ... *Phaseolus.*
            34. Seed 1 :
                35. Leaves under 7.5 cms. long ... *Psoralea.*
                35. Leaves 7·5 to 18 cms. long ... *Desmodium.*
            34. Seeds 2—3 :
                36. Lateral leaflets distinctly oblique ... *Desmodium.*
                36. Lateral leaflets not or very slightly oblique ... *Atylosia.*
    27. Herbs :
        37. Leaves simple ... *Tephrosia.*
        37. Leaflets 15—20 pairs ... *Sesbania.*
        37. Leaflets 3 :
            38. Pods 25 mm. or more in length :
                39. Diffuse, prostrate or erect ... *Phaseolus.*
                39. Twining or climbing :
                    40. Style bearded below the stigma ... *Phaseolus.*
                    40. Style not bearded below the stigma :
                        41. Leaves gland-dotted beneath :
                            42. Ovules 3 or more ... *Atylosia.*
                            42. Ovules 2—1 ... *Rhynchosia.*
                        41. Leaves not gland-dotted beneath ... *Dumasia.*

38. Pods under 25 mm. long :
43. Erect herbs ... *Mellilotus.*
43. Prostrate or diffuse herbs ... *Trigonella.*
43. Trailing or twining herbs ... *Rhynchosia.*

1. *Flowers pink, purple, violet, blue or lilac* :
44. Erect trees :
45. Leaflets 17—23 ... *Mundulea.*
45. Leaflets 3—15 (generally 4—7) :
46. Leaflets distinctly alternate ... *Dalbergia.*
46. Leaflets opposite ... *Pongamia.*
45. Leaflets 3 :
47. Trunk armed with conical prickles ... *Erythrina.*
47. Trunk unarmed :
48. Flowers rose-coloured, pods 3 — 7·5 × 1.6—2·5 cms. ... *Ougenia.*
48. Flowers orange or salmon coloured ; pods 12—20 × 2·5—5 cms. ... *Butea.*
44. Climbing shrubs :
49. Leaflets 5—7 :
50. Leaflets distinctly alternate ... *Dalbergia.*
50. Leaflets opposite ... *Derris.*
49. Leaflets 9–21 :
51. Leaflets distinctly alternate ... *Dalbergia.*
51. Leaflets opposite :
52. Leaves abruptly pinnate ... *Abrus.*
52. Leaves imparipinnate ... *Derris.*
49. Leaflets 3 :
53. Leaves gland-dotted beneath ... *Dunbaria.*
53. Leaves not gland-dotted beneath :
54. Style hearded below the stigma :
55. Pods subterete ... *Vigna.*
55. Pods flattened ... *Dolichos.*
54. Style not bearded :
56. Stamens monadelphous :
57. Pods with silky, long brown hairs. *Pueraria.*
57. Pods more or less glabrous ... *Canavallia.*
56. Stamens diadelphous :
58. Petals very unequal ... *Mucuna.*
58. Petals equal :
59. Flowers small, panicled ... *Spatholobus.*
59. Flowers large racemose ... *Butea.*
44. Erect shrubs or undershrubs :
60. Stamens connate or free, 10 ... *Taverniera.*
60. Stamens 9+1, diadelphous :
61. Shrubs armed with auxiliary spines ... *Alhagi.*
61. Unarmed shrubs :
62. Leaves 1— and 3—foliate on the same plant ... *Desmodium.*
62. Leaves unifoliate or simple :
63. Bracts 18 mm. long, broader than long ... *Flemingia.*
63. Bracts linear or subulate ... *Desmodium.*

62. Leaves trifoliate:
64. Pods over 5 cms. long ... *Phaseolus.*
64. Pods less than 5 cms. long:
65. Pods distinctly jointed. *Desmodium.*
65. Pods not clearly jointed:
66. Pods turgid ... *Pycnospora.*
66. Pods flattened ... *Pseudarthria.*
62. Leaflets 3—21:
67. Pods distinctly jointed, joints folded on one another ... *Uraria.*
67. Pods flattened, continuous or scarcely septate ... *Tephrosia.*
67. Pods turgid, cylindric, septate ... *Indigofera.*

44. Herbs:
68. Erect, prostrate or diffuse, but not climbing:
69. Stamens in two bundles of 5 each ... *Smithia.*
69. Stamens connate or free, but not 9 + 1:
70. Leaves simple:
71. Stem and branches glandular ... *Psoralea.*
71. Stem and branches more or less hairy, but not glandular ... *Crotalaria.*
70. Leaves trifoliate:
72. Pods thick, fleshy, subtetragonal ... *Cyamopsis.*
72. Pods narrow, linear, flattened ... *Kothia.*
70. Leaves 5-foliate ... *Clitoria.*
69. Stamens 9 + 1:
73. Leaflets 2 ... *Lathyrus.*
73. Leaflets 1 and 3 on the same plant:
74. Joints of pods turgid ... *Alysicarpus.*
74. Joints of pods flattened ... *Desmodium*
73. Leaves simple:
75. Anthers apiculate ... *Indigofera.*
75. Anthers not apiculate:
76. Pods one-seeded ... *Psoralea.*
76. Pods many-seeded:
77. Pods turgid ... *Alysicarpus*
77. Pods flattened:
78. Pods continuous or scarcely septate, dehiscent ... *Tephrosia.*
78. Pods jointed, separating into indehiscent joints ... *Desmodium*
73. Leaflets 3—21:
82. Anthers apiculate ... *Indigofera.*
82. Anthers not apiculate: ...
83. Flowers in leaf-opposed or terminal racemes ... *Tephrosia.*
83. Flowers in axillary, 2-flowered racemes ... *Clitoria.*
68. Climbing or twining.
84. Leaves 1-foliate ... *Grona.*

84. Leaves with more than 3 leaflets :
  85. Corolla uniform in colour, 6 mm. long ... *Glycine.*
  85. Corolla blue with orange centre 3·5—5 cms. long ... *Clitoria*

84. Leaves trifoliate :
  86. Style bearded below the stigma ... *Vigna.*
  86. Style not bearded below the stigma :
    87. Stamens monadelphous :
      88. Alternate anthers sterile, very small ... *Teramnus.*
      88. Anthers uniform :
        89. Corolla under 6-mm. long ... *Glycine.*
        89. Corolla over 2·5 cms. long ... *Canavallia.*
    87. Stamens diadelphous :
      90. Anthers dimorphous ... *Mucuna.*
      90. Anthers uniform :
        91. Calyx teeth distinct ... *Shuteria.*
        91. Calyx teeth not distinct ... *Galactia*

WILD LIFE RESERVES IN INDIA: BIHAR PROVINCE

BY

JAMAL ARA

(With a map and two tables)

Active wild life protection is a policy of recent origin in Bihar. There is no sanctuary which has been in existence for 20 years, and hence the only animals in whose case protection has helped multiplication are wild elephants. These have received adequate protection for the last 40 years in the Singhbhum forests where they have now become so numerous that some amount of control (either by trapping for sale or by transferring to other forests where elephants are not found) has become locally necessary.

At present there are 5 sanctuaries in the Bihar forests, occupying an aggregate area of 272 square miles. This aggregate figure represents 10 per cent of the total Government-owned Reserved and Protected Forests. The total forest area in Bihar, however, is over 10,000 square miles, and the sanctuary area is therefore reduced to 2·5 per cent of the total forest area. That is a fractional figure and does not contribute to wild life protection to any appreciable extent. Since the first sanctuary was created only in 1932 and two others have been notified as such only during the last two years, noticeable multiplication of wild life cannot be expected. Any assessment on this account is premature.

Shooting control has existed in the 2,000 square miles of Government-owned forests for a number of years and this has of course prevented the extinction of many animals, particularly deer. As all the Government-owned forests have been located in Chota Nagpur (i.e. southern districts of Bihar), animals in northern districts have not profitted from shooting control protection. Private owners of forests have not exercised any systematic control of shooting; in fact till all the private-owned forests were taken over by the Provincial Government by legislation last year, owners and others used to resort to massacres of animals by shooting by spot-light at night from automobiles. The position has, however, changed for the better. Since the Government took over 8,000 square miles of privately-owned forests under their own management by the enaction of the Bihar Private Forests Act, 1946, shooting control has been extended to all those forests now constituted as Private Protected Forests under that Act. As demarcation of 8,000 square miles of scattered private forests has not been easy, the enforcement of the shooting rules has not been possible so far. The existence of the rules, however, is a great improvement, and their enforcement can be expected in due course when demarcation is completed and proper forest administration established. It is expected that it will take another two to three years before such conditions would obtain and

then about 13 per cent of the total area of the province (the entire forested area) will have the benefit of some measure of wild life protection.

The present Minister for Forests in the Government of Bihar, Mr. Krishnaballabh Sahay, is very keen on a progressive forest policy, and he has publicly declared his intention to afforest another 5,000 square miles of tree-denuded wastes to give to the province a forest acreage about one-fifth its total area. Shooting control is expected to be extended to that entire forest area and within a decade an appreciable amount of tree cover and shooting protection for the wild life of Bihar can be expected.

While the future is one of promise, the present conditions are only better than what they were in the past, yet very unsatisfactory. As was stated earlier very little wild life has survived, and just ordinary shooting rules cannot be expected to yield results. There must be an increase in the area in which all kind of shooting, trapping and destruction of wild animals is totally prohibited. That is, there must be more sanctuaries, and bigger ones. A desirable target figure would be to put 10 per cent of the present forest area (both state-owned and Private Protected) under permanent sanctuaries. Another practical means to secure protection of wild life would be to declare each Forest Division (about 250 square miles) a sanctuary for ten years in rotation. Areas like Champaran, Hazaribagh, Palamau, Monghyr and Ranchi which have been much shot over in the past may be the first forest areas put under such notified prohibition of shooting.

Poaching is, of course, a problem that will have to be contended with. In the absence of a Game Department the tackling of this problem is difficult. The ordinary Forest Department staff is too small to deal with sylvicultural as well as wild life protection duties. The number of persons exempted from obtaining a licence for shooting even in Reserved Forests is legion. Almost all officials are so exempt, and so are the numerous owners of private forests now under protection. If exemption was abolished sufficient revenue could be raised to maintain a small Game staff, by converting all the present temporary and seasonal Fire Patrol staff into permanent employees charged with reporting both fire occurrences and offences against the shooting rules. As the fire patrols have no sylvicultural duties such an arrangement would be feasible.

The main problem that will confront those undertaking conservation of wild life in Bihar will be of game management or multiplication of the severely reduced stocks. Some species are very near to extinction. The rhinoceros of Champaran, the wild buffaloe of Purnea, and the black buck of Shahabad are the species in the most precarious condition. Even now a lone animal of these three species can be met, but unless sanctuaries are created in their habitat areas immediately any measure of protection might be too late.

So far the sanctuaries have not given any definite indication of the animals responding to protection, except in the case of elephants. Other animals have not multiplied nor is it possible to

BIHAR

Showing

WILD LIFE RESERVES

Scale 1"=About 90 Miles

report that they have become less shy than what they were before the sanctuaries were created. Forest Officers are subject to frequent transfers and are not able to observe the animals as well as they might like to. The position in the sanctuaries would improve if for each sanctuary a Game Forester could be appointed and trained to look after the wild life. Such an incumbent could also be trained into elementary management to secure the optimum conditions for the multiplication of the animals under special protection.

However, the value of sanctuaries is great. While the rhinoceros has received protection for about the same period as the wild elephant it has not multiplied in Bihar on account of the absence of any sanctuary in its habitat. On the other hand in Assam, where the Kaziranga sanctuary was established in 1906, the rhinoceros is claimed to have multiplied from a dozen to over 400. In the Duras of North Bengal also, the Jaldapara sanctuary was established in 1932 to give protection to about 30 rhino which have now increased to over 60. The last rhino definitely seen in Bihar was shot in Champaran in 1939 by a man who obtained permission on the plea that the animal had been already wounded by a poacher. Occasional rhinos do wander into Champaran and Purnea from the Nepal Terai where they are still in some number (under a protection law similar to that existing in Bihar but more effective on account of the smaller number of fire-arms in that country) and a sanctuary might start a process of multiplication. It might be mentioned in this regard that wild elephants in Singhbhum had become very scarce and multiplication began again when the sanctuaries were started by a pair straggling in from the adjoining Orissa States.

The shooting rules also need amendment. The exemption provisions must be abolished, and the Forest Officer in charge of an area must alone be considered competent to declare an animal dangerous and fit for destruction. At present there is much abuse of the District Civil Officer's powers in this regard to bye-pass shooting restrictions and licence fees. Tigers have suffered most from this lacuna in the shooting rules, and many animals innocent even of the blood of any cattle have been shot on trumped-up charges in the Reserves. During the thirties two tiger censuses were held by the Bihar Forest Department in the district of Palamau (considered best populated with tigers) and each time the number was less than 40. From the actual count of that single district it can be calculated that there are less than a hundred tigers in the entire province, and unless better protection is afforded to them in a few decades the species might be locally exterminated.

The shooting licence generally does not put a limit on the number of birds shot. Ground birds like pea-fowl, spur fowl, partridges, quails and the red jungle fowl which are found all over the Bihar forests have suffered very badly on account of the absence of any limit. Birds with arboreal habits have not suffered so badly, but the Purple Wood Pigeon (*Alsocomus puniceus*) believed to have become extinct in this area was re-discovered by Mooney in the Singhbhum forests in 1934, and has been frequently observed since then obviously benefiting from the creation of the Bamiaburu

and Sasangdaburu sanctuaries. The birds of the plains regions do not get any protection, and are trapped and shot in vast numbers every year. There is a definite necessity for converting one of the jheels of North Bihar into a bird sanctuary. Similarly there is urgent necessity for creation of sanctuaries in Champaran, Purnea and Shahabad districts for the protection of rhinoceros, wild buffaloe, and black buck respectively. As forest Divisions are in process of creation in Champaran and Shahabad, the creation of sanctuaries in those districts can be expected at an early date, but in Purnea special measures would be necessary. There are still 4 patches of forest in that district aggregating a little over 100 square miles. These have not been notified yet under the Bihar Private Forests Act. If they are notified some protection to the wild buffalo might accrue, as two of the patches border Nepal Terai and the Bengal Duars.

No special measures have been taken in any of the sanctuaries for the benefit of the animals inhabiting them, except the impounding of the waters of a stream in the Sasangdaburu sanctuary in 1938 to provide water for the rapidly expanding population of elephants and sambar. In the Bamiaburu sanctuary a fish pond and a swimming pool were constructed close to two major salt licks. The history of the creation of these sanctuaries is obscure; generally they were the work of individual forest officers rather than the carrying out of any settled Government policy. In the absence of a definite policy the progress has been patchy. Even now the Santal Parganas, one of the oldest Reserves area, has no sanctuary, and till 1946 in the Baresand block restrictions were placed only on driving and beating of game. One of the administrative difficulties in the creation of sanctuaries has been the rights of hunting (including an annual religious hunt) enjoyed by the aboriginal tribes, in which killing of animals is done each spring (month of Magh by the Hindu calendar) without any discrimination as to species, sex, age, size or gestative state of the game. This religious right has prevented the functioning of Parasnath Hill as a sanctuary. This is a well-forested tract of over 200 square miles, reaching a height of 4,480 feet and one of the rainiest areas of the Province with more than 85 inches of annual precipitation. The hill being a holy spot of the Jain community, the latter obtained over 40 years ago a judicial decision that no killing of animals should be permitted. That decision has been respected generally except by the aboriginal tribes and the poachers, and in regard to the latter the management of the Jain temple had no adequate staff to prevent poaching. Now that those forests are being managed according to a scientific system prepared by the Forest Department, there should be adequate staff to prevent poaching. But at the same time declaration of the area as a sanctuary would further help protection of wild life.

Religious sentiment has also so far secured the survival in some numbers of the *nilgai*, which live mostly in the cultivated plains region of the Ganges valley. It is, however, doubtful how long such protection would continue considering that the animals do a certain amount of damage to crops and that the religious feeling

is entirely based upon the local nomenclature of this antelope which mistakenly classes it as a 'cow'. A sanctuary in the plains region for this graceful animal would soon be necessary, though some measure of protection may be available to it should the reserves for the rhinoceros, black buck and wild buffalo be formed at an early date.

The funds for sanctuary development have so far been very small. In the past a few forest Divisions used to get a budgetted amount of Rs. 100 per year for expenditure on 'Game Improvement'. Since this year the amount in a few Divisions has been raised to Rs. 500 per year, but still the total budget provision under this head for the entire province is less than Rs. 3,500 in spite of the fact that the total Forest Revenue exceeds 50 lakhs of rupees.

TABLE I

AVERAGE NUMBER OF ANIMALS SHOT PER YEAR DURING THE PERIOD 1935-1942 IN THE 2,000 SQ. MILES STATE-OWNED FOREST OF BIHAR

Tiger	5
Tigress	1·4
Leopard or Panther	4·6
Wolf	1·0
Wild cats	1·0
Hyena	1·0
Wild dog	1·7
Wild elephant	0·9
Nilgai	1·4
Bison	1·2
Barking deer	4·6
Sambar	12·9
Chital	5·4
Wild pig	4·6
Hare	6·9
Jackal	0·7
Wild buffalo	0·4

Average annual revenue from shooting fees Rs. 603
,, ,, expenditure on game preservation Rs. 624
} Period 1935-1942.

N.B.—The average number shot is only for the State-owned forests. More animals per year were shot in the private forests, but the figures give an idea how poor the Bihar forests have become in wild livestock.

TABLE II

PARTICULARS OF WILD LIFE SANCTUARIES IN BIHAR

Name of Sanctuary	Established in the year	Forest Division	District	Area	Cover conditions	Animals	Animals benefiting most from protection
1	2	3	4	5	6	7	8
1. Bamiaburu ...	1932	Kolahan ...	Singhbhum.	50 sq. miles; elevation 1,200–1,600 feet, above sea level. Rain 60″.	Crop mostly *sal*, poor in places with evergreen patches along streams. Well-watered in places only; has 2 perennial streams. A fish pond and a swimming pool built by the Forest Department provide water throughout the year.	Elephant, tiger, bear, leopard, sambar, spotted deer, barking deer. Spotted deer are very rare and elephant few.	Sambar.
2. Songra ...	1935	Porahat ...	Singhbhum.	56 sq. miles; elevation 1,200–1,800 feet above sea level. Rain 55″.	Crop mostly thin and light *sal*, along a very busy road. There is only one perennial stream.	Elephant, bison, sambar, spotted deer, barking deer, mouse deer, four-horned antelope, tiger, leopard, bear, and wild dog.	.....

3.	Sasangdaburu.	1936	Saranda ...	Singhbhum.	36 sq. miles ; elevation 2,000 feet above sea level. Rain 70″.	Crop mostly good quality *sal* with evergreen patches in moist valleys. Very well watered with a number of perennial streams. A dammed stream provides ample water supply.	Elephant, tiger, leopard, bear, sambar, barking deer, spotted deer, wild dog.	Elephant and sambar. Animals very free; it is not unusual to find sambar grazing in the compound of the F.R.H. at Kumdi.
4.	Baresand ...	1946	Palamau ...	Palamau ...	50 sq. miles; elevation 1,000–1,500 feet above sea level. Rain 60″.	Crop *sal* and bamboo ; at places very thin and open like parklands. Very hot and dry in summer. One large stream goes through it.	Tiger, bear, leopard, bison, sambar, spotted deer, barking deer and wild dog,	The bison alone seems to have profitted from protection and can be frequently seen on the adjoining Netarhat plateau ; still very shy.
5.	Kodarma ..	1947	Hazaribagh.	Hazaribagh.	80 sq. miles ; elevation 1,000–1,500 feet above sea level. Rain 50″.	Crop mostly *sal*, thin and open with many mica mines and labour camps. Water supply is poor.	Tiger, leopard, hyena, foxes, deer (sambar, cheetal and kakar) plentiful.	.....

Abstract of Table II

Total number of sanctuaries	=	5
Total area of sanctuaries	=	272 square miles.
Percentage of sanctuary area in relation to forest area	=	2·5
Percentage of sanctuary area in relation to total area of Province	=	0·4%
Longest period for which sanctuary has been in existence	=	16 years.

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PRESERVATION OF WILD LIFE IN INDIA:

SUPPLEMENT TO THE ARTICLE PUBLISHED IN VOL. 47, PP. 602-622 OF THIS JOURNAL

BY

LIEUT.-COL. R. W. BURTON, I.A. (RETD.)

In its flora and fauna Nature has endowed this country with a magnificent asset which cannot fail to be appreciated by the people when they have been taught to realize what they possess, and the need for both conservation and protection. A considerable effort to that end was made in May this year (1948) through a 24 page pamphlet widely distributed by the Bombay Natural History Society in government and official circles in both Dominions, and publicized through the Press.

Although there has been almost no response from the public, there are indications that the Central and Provincial Governments now recognize that something should be done to conserve the varied fauna of the Indian forests to save it from the gradual extinction with which it is threatened.

But this is not sufficient. There is, it is submitted, urgent need in India for creating and stimulating, among the educated classes in particular, a real interest in the wild life of their country.

Some people are even saying that wild animals are a nuisance and should receive no mercy.

2. SOME ASPECTS OF CONSERVATION

Preservation of wild life has many aspects. Unreasoning insistence on the sanctity of all wild life will serve no useful purpose, since real human interests must prevail whenever these are in conflict with wild life. But all over the country, outside the reserved and other forests, there is much wild bird and animal life urgently in need of protection. Sanctuaries and National Parks are all very well for satisfaction of what little public feeling there may be in regard to wild life, but these alone cannot adequately conserve the wild creatures of this great country. It is essential to take a long view and introduce in all primary and secondary schools instruction of the children on intelligent lines; for it is the youth of today who have to be the conservationists of tomorrow, and without the support of public opinion in the future no efforts by governments will give lasting results.

3. INDIA'S STORY

'It is through our great culture, religion and art that India's story spread far and wide in the past' said the Prime Minister of India in April this year, and it is in those fields the people have now to vindicate their political freedom. But not least among the causes for the former renown of India has been that wonderful

variety of wild life which is now the vanishing inheritance of the people of today. It is the obvious duty of the governments and the people to guard and preserve this asset for posterity.

4. Value of Wild Life

Apart from consideration of profit to the national finances and of national pride, the spectacle of wild birds and animals in their natural surroundings is one of the greatest joys of civilized man. The study of them and of the marvellous flora of this land of Hind can, and should, give healthy interest and recreation to all classes.

In power politics a well informed public opinion is the world's greatest security. So also in regard to wild life; real and correctly informed interest on the part of the public is its greatest protection.

5. Duty of the Public and the Governments

Improvement in the fields of public health, of growing more food, of preventing erosion, of drink prohibition, of conservation of fish supplies and many other aspects of public life cannot be satisfactorily achieved by government efforts alone. The public also have their responsibilities, and unless these are discharged by the people no amount of effort on the part of the government can have adequate results. So also in this matter of wild life protection and preservation.

It is the obvious duty of both Central and Provincial Governments to employ all possible means of propaganda for the instruction and enlightenment of the people in their responsibilities such as outlined above.

6. Vanishing Assets

Much of the wild life of India, a large part of which is found in no other country in the world, is fading away and will certainly disappear unless adequately protected and conserved. In the more open and inhabited areas, it is the common people who have mostly to be relied upon to stay the hand of destruction. In the reserved forests and more remote tracks it is the man in the wilds who has to be taught and trusted to prevent the larger species from being reduced to that narrow margin which spells eventual extinction; and it is the weighty responsibility of the departments in control to protect the fauna and flora of those areas.

This responsibility cannot be satisfactorily discharged in either remote or accessible areas unless the executive staff of both the Forest Department and the Wild Life Department (if formed) consists of wholly trustworthy and impeccable subordinates.

Therein lies the success or failure of wild life protection and preservation in this or any other country.

7. Value of Wild Life

In all countries the encouragement of tourist traffic is recognized as being of both direct and indirect value to the State. In India there is much for the people of other lands to see and admire.

There is almost no end to the list of archæological treasures, of customs and habits of humanity which could be cited to illustrate the inexhaustible interest of India as a panorama of the past; there are endless subjects for the artist and photographer in scenery, in portraiture, in sculpture; but prominent among the magnets for attracting tourists is the spectacle of wild life, and its abundant attraction for all classes of sportsmen and sightseers.

8. Forestry and Wild Life

The claims of forestry and wild life are often in conflict. The system that has hitherto obtained, which combines forestry with wild life preservation and protection, is unsatisfactory. India owes a great debt of gratitude to the many officers of the Imperial Forest Service who, throughout their service, worked continually and persistently to enforce wild life protection laws and rules, and to have them perfected. To them is due such stock of the larger animals—deer in particular—as existed at the time of the transfer of power in 1947, and has been already, in a number of areas, so woefully reduced.

True preservation can never go hand in hand with true forestry. This has been proved in practice in many countries where it has been soon found that the objects and ideals of the two are sometimes antagonistic.

Protection and preservation are not synonymous. Protection alone may, in time, do definite harm if preservation is ignored.

To continue the protection and preservation of wild life which includes the organization and management of all National Parks, Sanctuaries, Reserves as the duty of a department already overworked, and none of whose officers have been trained in the required methods, is not practicable and should give way to better arrangements.

9. Necessity for a Wild Life Department

In other countries, which have tackled the problems of wild life protection and preservation with conspicuous success, forestry is under separate management, the two departments working in liaison when and where necessary.

A Wild Life Department means that continuity of purpose without which all endeavour is of no avail.

> 'Adequate and comprehensive laws are on our Statute books. These laws are not being adhered to and enforced owing to the responsible department being given dual duties, their other duties coming first and game preservation second. The immediate need of a special Game or Wild Life Department cannot be overstressed.' (Editorial in June 1948 issue of the *Journal of the Ceylon Game and Fauna Protection Society*).

This is the situation in India at the present time.

10. Duties of Wild Life Departmental Wardens

It is the first duty of a Wild Life Department to do everything possible to prevent conflict between game and human interests.

In Reserves and Sanctuaries, where such are necessary, in addition to the ordinary requirements of the Forest Department, roads, cart tracks and paths have to be kept in repair and others opened as found necessary. Boundaries have to be kept clean. Animals soon get to know these so well that they learn not to cross them during the shooting season in the contiguous Reserve. Rest camps and staff quarters have to be built and kept in good order, with wholesome water supply ensured; patches of jungle have to be cleared for grazing and then burnt off periodically; salt licks and water supplies have to be improved or provided. Detailed maps and plans have to be prepared. Animals in the Parks, Sanctuaries or Reserves have to be observed, local habits noted, and a near census taken and plotted on suitable maps for periodical review. Supervision of these activities are the duties of the Wardens.

Other Duties. A Warden has to be a trained observer, able to train and educate his staff, also to inspire them with enthusiasm and real pride in the well-being of the creatures under their charge.

From this it is obvious that all members of the staff have to be most carefully selected. They must be keen on the work before them; lovers of wild life; of sound health and good physique; amenable to discipline; trustworthy, and as far as possible unrelated to neighbouring population.

In the upper grades they should be able to read and understand the wild life literature, which should be provided.

A manual should be compiled for their general guidance.

Guards and watchers should be well paid, clothed, housed and cared for at all times and seasons.

11. Field Duties

The main activities of wardens lie in the field. They have to be most carefully selected from among applicants who have a real interest in wild life. When approved, they should be seconded to other countries to acquire knowledge of principles, methods, and all useful details. Besides field work there will be much office work such as mapping of areas; receiving and tabulating reports; directing enquiry into cases of ordinary poaching, spotlight shooting and other malpractices, and of alleged damage by animals; ordering and directing the destruction of proclaimed animals; issuing of licenses and permits, suggesting and aiding publicity work; general administration of the staff; dealing with correspondence and returns and all sorts of other business.

(*a*) One of the most important duties is the need to gain the willing co-operation of village headmen to whom, on his recommendation, rewards should be granted for good work and correct influence.

Unless village officers and revenue officials, the police, the subordinates of the Forest Department and the general public co-operate with the two departments and the Government, poaching cannot be held in check.

(*b*) A suggested check to curb night shooting from cars on roads passing through forests is (i) to appoint a couple of Ranger

road patrols, provided with jeeps or motor cycles, to make surprise visits to the haunts of such marauders; (ii) instruct constables on duty at certain key points to take numbers of all motor vehicles entering or emerging from jungle roads, and inspect them if need be; (iii) erect road barriers at night on selected roads, where motor vehicles can be stopped, inspected, and have their numbers taken.

Necessary powers could be provided for this.

(*c*) As aid for enforcing laws and preventing wild life exploitation there should be close co-operation between the Police and Customs, and of both of these with the Wild Life Department.

Is it not apparent that the Forest Department by itself cannot be expected to deal efficiently with all these matters, besides carrying out the multifarious duties pertaining to forest administration in all its branches? Can there be any doubt in the matter?

12. People's Parks

These already exist in, or near, a number of cities and larger municipalities, and are of several kinds. A park of this description has been recently formed near Bombay and styled a National Park. In course of time many more People's Parks will be established; and in view of the greatly increasing demand for land, for all purposes, near fast-growing towns it is necessary that speedy steps be taken to acquire land for these greatly needed parks. By reason of their situation all such existing parks, and those to be formed in the future will be sanctuaries for wild birds and small animals. The lay-out of future People's Parks should be planned with this in mind.

(*a*) In many People's Parks there could be museums to house archæological, botanical, geological, natural history and zoological exhibits; to show pictures of birds, animals, snakes and insects for the interest and instruction of the public.

Assembly of the people in these parks would afford suitable opportunity for loud-speaker talks by means of propaganda vans on wild life and kindred subjects. This is one of the many ways in which paragraph 5 above could be implemented.

13. National Parks

The more general meaning of 'National Park' is 'An area dedicated by statute to the preservation, not of this or that animal, but a community of animals, in fact, of Nature which means Nature militant, Nature maintaining the balance through the law of tooth and claw.' (H. G. Maurice). These areas are thus inalienably established for the preservation of the flora and fauna in all its aspects, and dedicated for all time to, and for, the people.

(i) Of the famous National Parks of the world, one such is the Yellowstone National Park in America and another the Kruger National Park in Africa which has an area of 8,000 square miles and was in existence for thirty years before public access to it was permitted.

(ii) In India there is the Hailey National Park in the Kalagarh Forest Division of the United Provinces, the precise area and design of which is not known to the writer. In Assam steps have been recently taken through notification in the Provincial Gazette to set aside an area of 800 square miles in the Tirap Frontier Tract to be known as 'The Frontier National Park' of which part of the boundary is the Indo-Burma frontier.

(iii) Some people think that once National Parks are in being the game in the rest of the country can go, and the sooner the better. In Kenya the strong Game Policy Committee of 6 unofficial and 4 official members, with an unofficial chairman, appointed in 1939, held a directly opposite view, viz., 'the formation of National Parks will justify still further intensification of game control measures, where necessary, but will certainly not justify any policy of laxity or uncontrolled slaughter. Recommendations of the Committee were held up by the War, but early in 1945 the necessary ordinance was enacted.

14. Sanctuaries

Sanctuaries are of several kinds. There are sanctuaries for the preservation of a particular species of animal, or for a special bird or group of birds; for general purposes such as areas of Reserved Forest in which no shooting is permitted for a year, or a series of years. In India there is a sanctuary in Bengal for the preservation of the Great One-horned Rhinoceros, and several for the same species and also for the wild buffalo in Assam.

General purpose sanctuaries have been formed in Reserved Forests of most of the provinces, and in a number of states.

(*a*) There are also strict Natural Reserves and Intermediate Zones which are not so designated in India. They have these in Ceylon. In the last named only, which corresponds with what we know as Reserved Forests, is shooting allowed under rules and conditions of licences.

(*b*) It is necessary for the well being of Parks and Sanctuaries that reserved forest should be contiguous with these on all sides so that the surplus stock of animals may overflow, risk of cattle disease be lessened and guarding made less difficult.

'All indigenous species of fauna and flora ought to be represented, but the introduction of exotic types of either should be religiously avoided.' (Stevenson-Hamilton.)

(*c*) Importation of cattle diseases into National Parks, Sanctuaries and contiguous Reserves should be guarded against in every possible way. Besides conveying disease, grazing cattle eat and trample down all vegetation, break stream banks and start gully erosion. Sand and silt work into pools stifling fish and aquatic life. The balance of nature is disturbed, the food supply of animals greatly lessened, and much damage done to struggling saplings. Goats, as is well known, are deadly enemies to forest growth and silviculture.

15. Bird Sanctuaries

In Ceylon, there are 21 sanctuaries chiefly for the preservation of bird life. In India there are none, so far as known to the writer (except one on a small scale at Seringapatam in Mysore State) specially for the protection of birds. In some parts of the country these are urgently needed for protection of egrets and other beneficial birds.

In India, all matters concerning the protection of wild life are regulated by 'The Wild Birds and Animals Protection Act, VIII' of 1912, and by Notifications and Rules under that Act and the Indian Forest Act, XIV of 1927, and other measures enacted by Provincial Governments such as the Game Act of the Central Provinces.

It is the opinion of the writer of this note that schedules to the various Notifications and Rules under the above, should only specify species of birds which may be shot (no snaring or other methods) during prescribed open seasons. They should declare birds of all other species to be absolutely protected throughout the year. This would tend to uniformity throughout the country in all the provinces, states and unions, and would much simplify matters for the public and the administration. It would greatly benefit the cause of wild life. There is a note on the subject in the August number of the Bombay Natural History Society's Journal (Vol. 47, p. 602).

Section 8 of Act VIII of 1912 provides for *bona-fide* defence of property; and in the Ceylon Ordinance of 1937 section 58 makes a similar provision.

16. Ceylon Ordinance

'An Ordinance to provide for the protection of the Fauna and Flora of Ceylon' became law on the 10th March 1937. This ordinance embodies practically all the Regulations and Principles of the epoch-making Africa Convention of 1933. It is a comprehensive and well-thought-out Act and, if it is continually and effectively enforced should ensure the survival of Ceylon wild life for all time.

Although this ordinance has existed for over 11 years it is the opinion of all in close touch with the question that wild life in the island is doomed unless a Wild Life Department is created to enforce the laws.

17. Action Required

It is suggested that the Central Board of Forestry outlined in paragraph 12-D. of the Proceedings of the All-India Conference of 6th September 1948, should pass this note in review, as also the contents of the 24-page pamphlet referred to earlier on in this note, and make such representations as are found necessary or advisable for India as a whole, and for each of the provinces, states and unions.

(*a*) It is hoped that the snaring of game birds, hares, antelope and gazelle will be wholly prohibited at all seasons throughout the

country, for the time has long gone by when snarers should be allowed to earn a livelihood in that way.

18. Formation of Sanctuaries and National Parks

In the formation of these much forethought is necessary. They have to be considered with the ultimate object clearly in view. Some will be just sanctuaries, and some will be intended to pass through the stages of strict Natural Reserves before achieving the status of National Parks. Others will be designed, from the commencement, as National Parks and, in such cases, action would be taken after the most mature consideration from every point of view. All animals depend for their existence upon a suitable environment, and this should be preserved, as far as may be, intact for wild birds and animals.

(*a*) *Water.* 'Ordinarily, game will not graze more than six miles away from drinking places in the course of a day.' (Kruger Park).

Where there are perennial streams, lakes, marshy places, etc., no problems arise. But in some parts of India seasonal streams cease to flow; pools form and dry up; animals have to dig in the sand for water. At such times animals suffer much. They become a more easy prey to carnivora and the ubiquitous poacher. Not so many years ago, at time of a famine in the Central Provinces, animals—even tigers—were found drowned in wells adjacent to villages.

In the Kruger National Park, at the present time (1948), the question of water supply is a serious problem to the park authorities. As much as a quarter of the park area is hardly ever grazed in any year, and in dry years extensive parts of the park are untouched.

Here is an object lesson as to need for a very long view regarding the vital question of water supply in all parts of the area.

(*b*) *Food.* Needs of all the species in the area have to be considered. It may be necessary to de-forest selected level patches of jungle to provide grazing. In these, and in jungle valleys, annual grass-burning is a necessity, for neglect in this allows excessive growth of bush and thorny scrub which comes up with rapidity, blocks the glades, and through increasing denseness of the vegetation causes migration from the area of animals such as sambar and chital.

To promote prosperous breeding seasons there must be plenty of grass and water.

The needs of bison and buffalo have also to be thought of and improved if necessary. For some of the animals, and for birds, squirrels, monkeys and other creatures fruit-bearing trees and shrubs may have to be planted. In fact, the question of food also has to be considered in all its aspects.

(*c*) *Wild Buffalo.* It is desirable to foster the restoration of herds of these fine animals to something approaching their former number in the forests of South-east Chanda, Bastar, Jeypur and other parts of the erstwhile Eastern States area.

(*d*) *The Sloth Bear.* This animal—peculiar to Ceylon, India and Assam—is no longer found in some parts where once common, and is in need of both protection and preservation. Hitherto it has not been protected in any area of its habitat in this country. It should receive protection in a number of areas from which it is fast disappearing; and should be preserved in all parks and sanctuaries situated within its natural habitat.

(*e*) *Beasts of Prey* other than wild dogs, should be allowed in each park or reserve where they at present exist. So long as their numbers do not become excessive, tigers and panthers have a useful place in nature. If one animal is stressed at the expense of another the balance of nature is upset and disastrous results may follow. The policy should be not to interfere with nature, unless shown by periodical censuses to be absolutely necessary.

When tigers and/or panthers are unduly killed off, deer greatly increase, also wild pig. The deer take to barking trees in forest plantations, and both species encroach on cultivation, for which they will travel long distances.

Surplus deer population, should that arise, can be controlled by shooting of hinds, which is a well known practice in all deer forests in Europe and has been found necessary in some states of the U.S.A. In most forests in India the carnivora exercise the necessary and natural control.

The obverse is also true. In many parts of this country at the present time deer have been so much killed off that tigers increasingly prey upon the cattle and not infrequently take to man-eating.

19. Conditions Governing the Formation of Sanctuaries

Sanctuaries, if they are to be effective, must, among other considerations:—

1. be suitably sited with sufficiently well distributed and permanent water supplies for the several species;
2. be sufficiently large to allow animals to live in them all the year round without inducement to wander outside. About 300 square miles may be taken as a minimum.
3. contain no human habitations or cultivation;
4. comprise natural game country having abundant water, food and cover;
5. be free from grazing rights, since domestic cattle spread disease besides reducing the food and water supplies; they also disturb the forest and give opportunities for poaching;
6. be undisturbed by timber extraction and other forest works;
7. possess security of tenure and not be liable to sudden changes of constitution or control;
8. be sufficiently inaccessible to prevent the animals being molested and harassed by villagers and others encroaching upon their boundaries;
9. be sufficiently accessible to permit of frequent inspection by responsible officers and their staff. To facilitate this they must have necessary motorable roads, cart-tracks, and riding or foot paths.

For each sanctuary one or more riding elephants are essential to facilitate proper inspection of the area at all seasons. In many forests this work is otherwise too exhausting to be thorough.

20. Sportsmen

It is most desirable that sportsmen of the right type should be given every encouragement to visit the contiguous reserves, as also the more remote forests. They should be asked to endeavour, by precept and example, to teach the villagers to take more interest in the local fauna and its protection.

Permit holders should be invited to enter, in the form provided on reverse, both positive and negative information as regards the numbers and conditions of game in the Shooting Block by replies to listed questions such as 'How many of each species of game did you see? How many tigers, panthers, bears do you think were in your block? Did you see any signs of illicit shooting such as pits, machins, hides near water or salt licks? Did you hear shots fired by day or by night and, if so, in what locality?'

Remarks on headmen and shikaris would be appreciated; also any unusual incidents.

21. Conclusion

Without a Wild Life Department as suggested herein the survival of much of the wonderful wild life of India is inconceivable and a great national asset will disappear, never to be regained as the majority of the unique species will become extinct.

Acknowledgment for use of material is made to the editors of the Journal of the Society for the Preservation of the Fauna of the Empire, the Journal of the Bombay Natural History Society, the Journal of the Ceylon Game and Fauna Protection Society; also to contributors to the above for use of their writings, which have been of much assistance.

MICROCOS BLATTAEFOLIA (CORNER) SESHAGIRI RAO, NOV. COMB.

BY

R. SESHAGIRI RAO

The Herbarium, Royal Botanic Garden, Calcutta.

= *Grewia latifolia* Mast. F.B.I. I, 392 (1874) non *G. latifolia* Muell. ex Benth. Fl. Austral. I, 271 (1863).

= *Microcos latifolia* (Mast.) Burret, Notizblatt Bot. Gart. Mus. Berl. IX, 601 & 757 (1926).

= *Grewia blattaefolia* Corner, nom. nov., Gard. Bull. Straits Settlements X, 262 (1939).

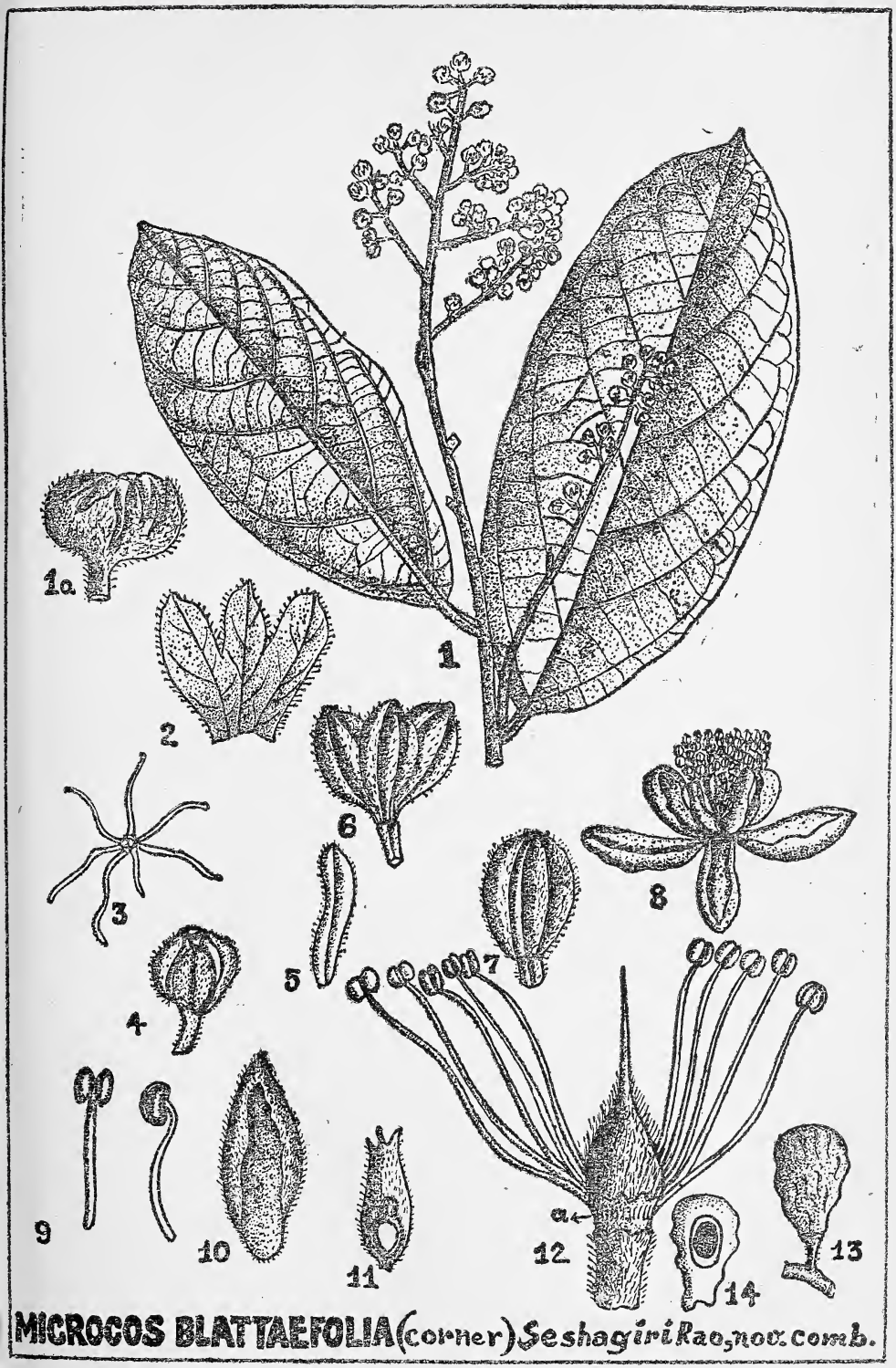
Linnaeus in Species Plantarum (1753) described *Microcos* as a genus distinct from *Grewia.* But, later workers like Jussieu (1804) and Roxburgh (1832) sunk *Microcos* into *Grewia,* though the former genus was recognised and maintained as a distinct one by Willdenow and Smith (1819) William Jack (1830) and G. Don (1831). Later, in 1862, Bentham and Hooker described *Microcos* as one of the sections under the genus *Grewia,* and this was followed by Masters and subsequent flora writers. In 1926, Burret separated the two sections, *Omphacarpus* and *Microcos* from the genus *Grewia* and relegated all the species of the two sections to the genus *Microcos* Linn. on the basis of many distinct floral characters. Hence, he changed the nomenclature of several African, and Malayan species of *Grewia* which possessed the characteristic features of the genus *Microcos* Linn. This view was later supported by Merrill, Ridley, Tanaka and quite recently by Masamune. But in 1939, Corner disagreed with Burret, on the plea that as the difference between the two genera, *Grewia* Linn. and *Microcos* Linn. was not so great as to raise the latter to a generic rank, he would follow the customary interpretation of *Grewia.* Corner however had changed *Microcos latifolia* (Mast.) Burret to *Grewia blattaefolia* Corner, a *nomen novum,* as Master's name *G. latifolia* Mast. cannot stand either in *Grewia* or in *Microcos,* being a later homonym to *G. latifolia* Muell. ex Benth. (*wide* : Art. 61 of the Int. rules of Bot. Nomenclature). *Corner's* new name *G. blattaefolia* referred to the leaf shape : like a cockroach's wing.

The writer, during the course of his study on the Indo-Burmese species of *Grewia,* has examined many Malayan and African species of *Grewia* which have been changed to *Microcos by* Burret. He found it difficult to combine *Microcos* with *Grewia* due to the striking dissimilarity of appearance of all the species of *Microcos* with those of *Grewia* and other features peculiar to them as given in the description below.

Therefore, the writer agrees perfectly with Burret in raising the two sections, *Omphacarpus* and *Microcos* to generic rank under *Microcos,* Linn. and as such, *Grewia blattaefolia* Corner is therefore transferred to *Microcos* renamed as *Microcos blattaefolia* (Corner) Seshagiri Rao, nov. comb.

DESCRIPTION :

Tree 6-24 meters high with spreading branches ; *Stem* 45-60 cm. in diameter, tender branches ferruginous, stellate hairy ; *Leaves* dull dark green, 15-25 cm. long 7-13 cm. broad, alternate, petiolate, 1.5 cm.-2.5 cm., rusty tomentose, leaf base sub-unequal, nearly ovate (blattae-form), entire, abruptly obtusely acuminate or sometimes obtuse, coreaceous, glaucous on the dorsal and finely hairy on the ventral, 3-nerved at base, pinnately reticulate with nerves prominent and running more or less parallel on the ventral ; *Cymose panicles* large, compact, usually terminal, sometimes axillary, peduncle and pedicles thickly covered with stellate hairs, light rusty-red ; *Cyme* 3-flowered, covered by 3 outer large trifid bracts and 3 inner thin, narrow bracts alternating the outer, stellate hairy ; *Flower* pale green with a silvery tinge ; very short-stalked (appearing as sessile), actinomorphic, hermaphrodite, hypogynous ; *Sepals* 5, free, valvate, margins incurved, stellate hairy ; *Petals* 5, free, imbricate, hairy, apex slightly dissected, nectary on the inner oval hollowed base fringed by fine hairs ; *Stamens* numerous,



MICROCOS BLATTAEFOLIA (corner) Seshagiri Rao, nov. comb.

free, light yellow, on a short disc-like androgynophore; filaments long, hairy; anthers dithecous, introrse, versatile, dehisce by longitudinal slits; *Ovary* superior, monocarpellary, hairy on a short androgynophore; *Style* short, slender; *Stigma* punctiform; *Ovule* solitary, basal; *Drupe* obovate, smooth with leathery epicarp, fibrous mesocarp and stony endocarp; *Seed* small, albuminous.

DISTRIBUTION :

This species is mostly confined to the Malayan Peninsula and the Malayan Archipelago. It is seen commonly growing in dense or open hilly jungles at different altitudes ranging from 100 feet to 1000 feet. (30-300 metres).

MATERIAL EXAMINED :

Malayan Peninsula : Larut, Perak (King's Collector Nos. 3302 ! 4162 ! 4268 ! 4501 ! 4749 ! 6197 ! 6697 ! 7762 ! 7950 ! 10177 ! 10429 !); (Kunstler 3302 ! 6697 !); (Scortechini No. 195 b !) Salama, Perak (Kunstler 3129 !) Malacca (Griffith No. 638/1 !); (Maingay 245 ! 1576 A !); Botanic garden, Singapore (King collected on 8th Sept., 1879 !) (Nur, Singapore Herbarium No. 18189 !); Bukit Timah, Singapore (Ngadiman, Singapore Herb. No. 34971 !) (Ridley 4943 !) Tanglin, Singapore (? 10645 !); 5th Kota Tinggi, Mawai Road, Johore (Corner, Singapore Herb. No. 31500 !)

Malayan Archipelago : Sarawak, Near Kuching, Borneo (Haviland and Hose 1685 !)

SUMMARY :

(1) The species of *Grewia* under the two sections, *Omphacarpus* and *Microcos* are now transferred to the genus, *Microcos* Linn., and hence *Grewia blattaefolia* Corner is changed to *Microcos blattaefolia* (Corner) Seshagiri Rao, nov. comb.

(2) The species is described in detail.

Acknowledgments : The writer wishes to express his thanks to Dr. K. Biswas and Sri V. Narayanaswamy for their helpful suggestions and encouragement.

EXPLANATION OF PLATE.

Fig. 1. Twig with inflorescence × 1/3.
Fig. 1.a. Compact 3-flowered cyme × 3.
Fig. 2. Trifid bract showing the nerves on the inner surface × 5.
Fig. 3. Stellate hair (Highly magnified).
Fig. 4. 3 buds with three inner narrow bracts × 4.
Fig. 5. Narrow inner bract × 5.
Fig. 6. 3 buds in cluster (inner and outer bracts removed) × 5.
Fig. 7. Flower bud × 6.
Fig. 8. Open flower showing the arrangement of calyx, corolla and androecium × 6.
Fig. 9. Stamens with ventral and side views showing the versatile attachment. (much enlarged)
Fig. 10. Sepal showing inner surface with the margins incurved × 8.
Fig. 11. Petal showing dissected top and nectariferous inner hollowed base × 15.
Fig. 12. Androecium and gynoecium on androgynophore (*a*) showing long, smooth filaments, hirsute ovary and punctiform stigma (much enlarged).
Fig. 13. Drupe with wrinkled epicarp (nat. size).
Fig. 14. Longitudinal section of drupe showing its three walls and a seed (nat. size).

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THE STUDY OF INDIAN MOLLUSCS

BY

JAMES HORNELL, F.L.S., F.R.A.I., (Deceased)

PART I

(*With 28 text figures*)

The commonest objects on Indian sea-beaches are the shells of those soft-bodied animals called by zoologists *mollusca* and popularly known as *shellfish*. These names appear at first sight to be contradictory, for while the scientific term signifies that the animals are soft-bodied, the popular name implies that they are encased in a hard, protective covering, the shell. Combining the two ideas we get a fairly clear comprehension of their outstanding and obvious characteristics—soft-bodied animals protected by an outer casing or armour, usually hard, composed of some form of limy or calcareous material, and without any internal skeleton except in very exceptional instances of which the cuttlefishes are examples; sometimes both external and internal skeletons are wanting—of these many garden slugs are familiar instances; others are the naked-gilled sea-slugs (Nudibranchs), often of brilliant colouring and fantastic form.

The shells of mollusca are extremely diversified in shape, size and colouring. Each may consist of two parts or *valves* as in the oyster and the mussel (*Bivalves, Lamellibranchia* or *Pelecypoda*); of a series of plates as in Chiton, the 'coat-of-mail shell' (*Amphineura*), or of a single piece, in most cases spirally twisted (*Gastropoda*); finally come the highest of the group, the *Cephalopoda,* comprising the most active and intelligent of all the mollusca—the octopus, cuttlefishes and squids, together with the pearly nautilus and the great hosts of fossil ammonites and belemnites. A division (*Scaphopoda*) has to be made to receive the Elephant-tusk shells, a small number of peculiar forms with long tapered shells well described by their common name.

The body of a mollusc as seen among typical gastropods consists of four regions, anterior, posterior, dorsal and ventral. The anterior one, marked out as a distinct head, bears the mouth, tentacles and the chief organs of sense—touch, sight and smell. Behind this is a swollen dorsal mass, the visceral sac, containing the stomach, intestine, liver and reproductive organs. The outer integument of this region is the mantle and this is generally disposed in a fold reflected over the back of the animal. The outer surface of the mantle secretes the shell; in bivalves the mantle is double, formed of a free fold or flap on either side of the body, thereby orginating the two valves or half-shells characteristic of these molluscs. On the ventral aspect of the body below the visceral mass is a large and muscular organ, the foot, flattened and specifically adapted for crawling in the gastropods and chitons; generally small and insignificant and usually tongue-shaped among bivalves—sometimes virtually absent, so small and vestigial is it; among cephalopods it

is split up into a number of mobile arms beset with scores or even hundreds of button-shaped suckers.

The mollusca are a difficult problem for the evolutionist; they appear in groups generically distinct and as fully differentiated in the lower Palaeozoic strata as they are at the present day; gastropods and lamellibranchs are found in the Cambrian and the remaining classes in the Ordovician or Lower Silurian. There is no geological sequence to help us to a decision. We have therefore to see what assistance embryology can afford; here we get a definite hint from study of the larval history of certain groups. We often find that at a particular stage in the development of many molluscs a characteristic larval form occurs having a tiny globular body furnished with a circlet of cilia round the middle; the lashing of the cilia causes it to spin top-wise through the water. This larva is termed a trochosphere; it is practically identical with the larvae of the bristle-worms (*Polychaeta*), which when adult usually develop a head bearing tentacles and eyes and which in many families have both horny jaws and a gullet armed with a series of horny teeth. Now, with the exception of the lamellibranchs, the other classes of molluscs (again with the usual qualification of ' exception ' that meets us at every turn in the study of zoology) possess a ribbon-shaped tongue or *radula*, set with rows of microscopically small teeth; these molluscs generally possess a definite head, bearing eyes and other sensory organs.

If therefore the larval history of molluscs points directly to an ancestry common to those marine worms which are typically furnished with a well-marked head and often have pharyngeal teeth, we are justified in concluding that those molluscs with a head region and a radula are nearer akin to the ancestral form than are the lamellibranchs, which have diverged in a major degree in order to fit themselves for a sedentary life. This change has led to the loss of a specialized head region and of the toothset radula. In specializing, they have become degenerate in several vitally important directions (Fig. 1).

Class I.—AMPHINEURA

The **Chitons** or Coat-of-mail shells are the only members of this class that need concern us. As among the gastropods proper the foot is well developed as a crawling organ, flattened and extending the whole length of the elliptical body. The species most common in Indian waters grow to a length of 1½ to 2 inches. They live among rocks, generally between tide-marks and often may be seen adhering to the sides of rock pools on the Bombay and Malabar coasts and on the shore reef at Rameswaram.

They are readily recognized by the jointed shell protecting the back. It is made up of eight distinct plates fitted to overlap one another like a series of roof tiles. When detached from their foothold, chitons roll up into a ball like the short millipede or like the armadillo and the hedgehog. All our Indian chitons are sluggish creatures feeding on the smaller seaweeds clothing the adjacent rock surfaces. One outstanding interest they possess is the fact

that some species have developed very minute eyes, complete with lens, retina and pigment, upon the surface of the shell plates. Often these number thousands in a single individual, always most numerous on the most anterior plate. Chitons have no economic importance in India.

Unlike the gastropods proper, the body and organs of chitons are bilaterally symmetric, that is, the right side of the body is exactly like the left. The head is at the front end, and the gullet, stomach, and intestine form a straight tube through the body, ending in an anus at the hinder end. The breathing organs are a series of plate-like gills arranged on each side, between the muscular foot and the edge of the thick leathery mantle in which are sunk the eight plates that form the shell. Like the alimentary canal, the heart is straight and tubular as in the ancestors of the bristle-worms from which the mollusca may also have been derived. These points are important to remember for we shall find in the gastropods striking divergences from these simple and probably ancestral characters.

Class II.—GASTROPODA

Sub-class I.—*STREPTONEURA*

Order I.—Diotocardia or Aspidobranchia

The Limpets (*Patellidae*)

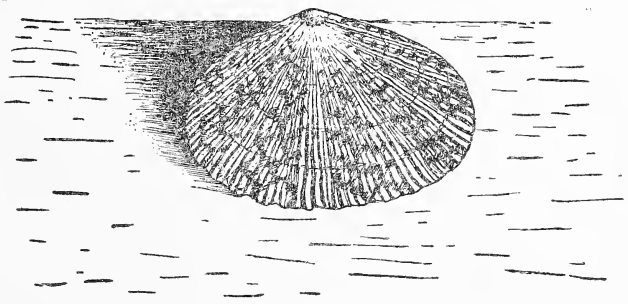

Fig. 1.—A common Indian Limpet—*Cellana*.

The most primitive and simplest of the molluscs included in this order show distinct kinship with the Chitons and serve to bridge the gap between them and the spirally-coiled shells distinctive of the great majority of the gastropods. Of such primitive forms are the Limpets. In these molluscs the shell is conical and forms a stony cap under which the animal lives secure. As among the chitons the limpets have a broad sole-like foot. This gives them power to cling tenaciously to the rocks on which they have their home; the broad muscular foot-disc functions after the manner of a boy's leather sucker; by the total exclusion of air from beneath it, atmospheric pressure comes into play and has to be overcome before the limpet can be pulled away from its foothold. As atmospheric pressure at sea-level amounts to 15 pounds to the square inch and as the conical shape of the shell affords no grip to the fingers, it is well nigh hopeless to try to detach a limpet from its rock

unless we can take it unawares; then when the edges of the shell are raised slightly, a knife slipped deftly underneath will effect dislodgment of the animal by a sudden wrench, before contraction of the foot muscles enables it to create a vacuum beneath.

Limpets live between tide-marks on rocky coasts. They are not very abundant in India and are usually small. When suitable rocks occur they are often to be found so near to high-tide level that the sea leaves them high and dry for several hours twice a day. They feed upon the smaller seaweeds covering rock surfaces in a thin, velvety mantle. On coasts where limpets abound I have often heard a continuous low rasping hum rising from the rocks around. It was meal-time with the limpets; a multitude were browsing on the tiny weeds growing on the rocks, the noise arising from the file-like action of myriads of minute teeth. The radula or dental ribbon of the limpet is longer than the animal's whole body. In the common British limpet nearly 2000 teeth have been counted on the radula, set in about 160 rows of 12 teeth each. The hinder part lies coiled up like a watch spring. New teeth are continually being formed at the inner end and the ribbon unrolls a little as required to make good the waste going on at the front end from the wearing down of the teeth in use. Limpets have a well-marked homing instinct and though they may crawl several feet away from their home, they return there regularly from their foraging expeditions. In soft rocks they rasp out quite a deep pit at the place they choose for a home; on hard rocks this spot is recognizable by its smoothness and may even be a little lower than the surrounding surface.

In Europe the poorer classes in several countries—France, Italy, Ireland—value the limpet as a cheap delicacy; very large quantities are collected and eaten. In India their food importance is almost negligible; so far as I know it is only at Covelong, on the Madras coast, where they are more numerous than I have seen anywhere else in India, that some of the poorer people are accustomed to collect them to eke out their meagre diet. They are known there as *Unai* in Tamil.

The common Indian species are *Cellana radiata* and a race of *C. cernica* (Fig. 1).

The **Key-hole limpets** and **Slit limpets** (*Fissurellidae*)

In shape their shells resemble closely the true limpets, but have either a perforation at the apex or a tiny slit in the front margin of the shell. The use of these apertures is to ensure the removal of foul matter. Pure water is admitted to the gills through the space between the edge of the shell and the rock surface beneath and then is passed out through a tubular fold of the mantle discharging at the apical hole or at the notch in the front edge, washing out at the same time any excreta that require removal. Indian species are all small and consist of a few species of the key-hole limpet (*Diodora*) and of the rarer and smaller *Emarginula*, one of the slit limpets. These live below low-tide line and are seldom found except by dredging. Dead and worn shells are occasionally cast up on the beaches.

Ear-shells (*Haliotidae*)

Closely allied to the preceding families are the Ear-shells or *Haliotidae*. A common Indian species is *Haliotis varia,* found attached, limpet-fashion, to rocks and boulders at and below low tide level. This species is quite a small one, seldom exceeding 1½ inch in length—a poor representative of the family. In other lands, in France, Japan, New Zealand and California, ear-shells attain a length of 4 to 6 inches, and vie with the rainbow in the gorgeous colouration of the mother-of-pearl lining of the shell. As a consequence it is extensively used for pearl inlay. A notable instance was brought to my notice some years ago when a P.W.D. officer in the north of India sent me a fragment of iridescent pearl shell with the request that I would tell him where it could be matched. It came, he said, from a beautiful mosaic inlay in the interior of that gem of architecture, the tomb of the Muhammadan saint, Selim Chisti, built within the courtyard of Akbar's mosque at Futehpur Sikri. The fragment proved to be a piece of a large *Haliotis* shell, of a species not found in India but common in Chinese seas whence it must have reached India in trade.

Pearls are not uncommon in the mantle but their value is low, for coloured pearls are little in demand.

Wherever it is found, the ear-shell is valued highly as food; its great muscular foot is a delicious morsel when properly prepared and cooked. The Chinese especially value it and great quantities are exported to China from Japan and California. It may either be cured dry or put up in tins—the *abalone* of Californian markets.

In shape *Haliotis* looks like a huge flattened limpet with a row of holes piercing the shell along the left margin. The function of these is more specialized than is the apical hole in the key-hole limpet, for here it is only the most posterior one which is used as an anal funnel to get rid of impure water and debris, whereas the others, several in number, are used to *admit* water to the gills—inhalant apertures.

In the ear-shells, although the general shape is flattened, the essentially spiral form is clearly apparent at the hinder end where a short but distinct shell-coil is seen when examined carefully. In the vast majority of gastropods this spiral twist is greatly emphasized and in the next family to be described, the Top-shells, this characteristic is fully established. Molluscs of this type are said to be highly asymmetrical; however, this lack of symmetry is confined mainly to the visceral mass; the mantle, the shell and the gills are also affected by this twisting. The foot and the head with its sensory organs usually remain as symmetrical as in the Chitons. In other words the 'back' of these animals has been twisted and coiled into a spire, and the shell has to conform to this modified shape as it is formed by shell-forming secretions poured out by the fold of integument covering the viscera.

Top-shells (*Trochidae*) and **Turban-shells** (*Turbinidae*)

These may conveniently be taken together. They are much alike in appearance, both comprising some of the commonest of our littoral shells. In shape they are conical and are beautifully pearly within.

The larger kinds are commercially valuable; the widely spread 'Trocas' shell of trade (*Trochus niloticus*) and the even more valuable 'Green Snail' (*Turbo marmoratus*) of Eastern seas are in great demand for pearl button manufacture.

The two families are easily distinguished by the nature of the operculum, a flattened hard structure found upon the upper surface of the tail end of the foot in many gastropods. When the animal, alarmed or attacked, retires into its shell, the operculum serves as a door to close the mouth and to keep the intruder out. In the Top-shells it is horny and marked with a closely set spiral; in the Turban-shells it is stout, massive and plano-convex in shape, the rounded side outer—some are so large as to be heavy enough for use as paper weights, quite two inches in diameter. The opercula of one species, *T. petholatus*, found in the South Seas, vividly mottled with flushes of green and brown, are worked in Fiji into fancy jewellery, very attractive when artistically mounted in gold or tortoiseshell; in former days the Maoris of New Zealand used these opercula as eyes for their idols. Even in India the opercula of *Turbo* have value. They find place with all sorts of local shells and marine curiosities in booths within the main entrance to Rameswaram temple, for sale to the pilgrims and devotees who flock there in thousands from all parts of India. The perfect ones are retailed at eight annas a thousand, sea worn ones at considerably less. The Tamil name is *ambiliman*, 'the disc of the moon'. The flesh of *Turbo* is eaten by the island people (Valayans) but that of *Trochus* is not esteemed owing to the small size of the local species.

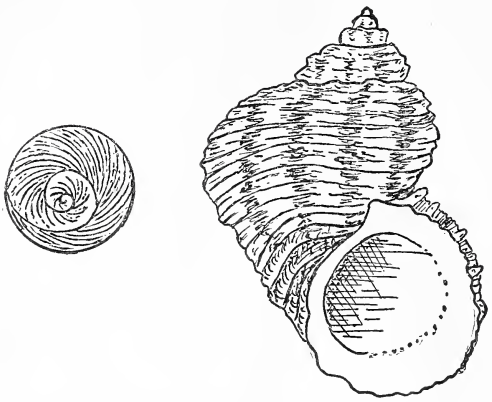

Fig. 2.—*Turbo argyrostomus* with a view of the inner surface of the operculum. ×1.

All our species of *Turbo* and *Trochus* are small except a few in the Laccadive Islands where a commercial 'Trocas' (*T. pyramis*) is sometimes found, together with some fairly large Turbos (*Turbo argyrostomus*). Sometimes on overturning a boulder in the scrub near the beach in these islands, a score or more of big Hermit-crabs scurry away, the majority hiding their soft tail in a big *Turbo* shell (Fig. 2).

A rather pretty Top-shell (*Clanculus clanguloides*) is not uncommon in the Pamban neighbourhood. Like other species the sides of the body are fringed with a number of long and slender tentacle-like filaments.

Most common of all the Trochidae is the beautifully variegated and polished shell of *Umbonium* (*Rotella*) *vestiarium*, a little species that occurs at the mouths of sandy backwaters in enormous numbers. It is one of the most dainty of little shells. Usually about

a quarter of an inch across, its low depressed spiral shell is stippled and marbled in dozens of variations and in a range of colour from pink to brown. Some are nearly white, so few and pale are the markings, while others are deep chestnut, so closely set are the spots. Millions must be exported to Europe, for this shell is one of the chief of those used in the ornamentation of shell-boxes sold at every watering place in England.

Grouped with the Turbos are the Pheasant-shells (*Phasianella* spp.), prettily patterned tiny shells that occupy to the Turbos much the same relation as the handsome *Umbonium* does to the true Top-shells. Their polished shells are to be found on rocky shores at the edge of pools and in sheltered crevices. They are gregarious, and, like *Umbonium,* the patterns and tints of their colouration vary enormously.

Nerites

The Nerites show unusual adaptability to varying conditions. *Nerita* lives in the sea, on rocky shores and reefs and can be picked up just below high-tide level. The closely allied *Neritina* is a fresh-water genus, though it may also be found in brackish estuaries. A third genus, *Septaria* (=*Navicella*), is still farther removed from the ancestral marine form, for it has actually acquired the habit of living in places on the banks of streams where it is only kept damp by spray or the lapping of water on the rock or tree root or trunk to which it adheres. The series of transition forms seen here is an excellent illustration of how fresh-water faunas have arisen and how, from these, the land molluscs may in turn have evolved.

Considering their size—barely three-quarters of an inch in length —the shells of Neritas are extremely massive. They live at the edge of the sea and are often tumbled off their lodgement on the rocks by waves; were they less strongly built their shells would be broken and destroyed.

The shells show externally distinct spiral markings on one side, the apex; internally in adults the whole cavity is simple and rounded. Study of the life history of *Nerita* shows that it begins life with a shell furnished with a well-marked spire wound round a central column, the *columella.* As growth proceeds the columella and whorl partitions are gradually absorbed. It would seem that the animal has to be so busy with strengthening the external wall of its dwelling that it can spare no limy material for interior decoration. The shell is often prettily marked—it varies greatly—and in old ones the surface is much corroded and pitted; here it is appropriate to mention that mollusc shells are normally protected against damage by a horny skin, the *periostracum,* or else by folds of the mantle wrapped over them; if the periostracum be worn away, the exposed limy shell beneath is liable to chemical corrosion, especially in shells often exposed by the receding tide.

As in the Turbos the operculum in the whole family of the Nerites is stony. Usually it is semi-lunar in shape. At one end is a finger-like projection that hitches behind the columellar lip and forms a locking device, giving additional security. A peculiar little Hermit-crab (*Coenobita rugosa*) that frequents the upper beach and

lives almost entirely out of water, finds the empty shell of *Nerita* just ideal to its wants; indeed it has adapted the shape of its big claw so precisely to the form of the mouth of the shell that when it withdraws inside, the big claw closes the aperture as perfectly as did the operculum of the original owner.

In the fresh-water *Neritina* the shell is thinner and the spire even less evident; finally in *Septaria* the spire is so completely lost that the shell may easily be mistaken for that of a small and narrow limpet. Internally the columellar lip persists as a thin ledge and there still remains a little operculum, too small to fit the aperture and more or less embedded in the foot. *Neritina crepidularia* is a common species in the Bombay area.

Order II.—Monotocardia or Pectinibranchia

In these gastropods the heart has a single auricle; the gill is also single, with a single row of plates (monopectinate). The body is greatly twisted; this has the result of causing the shell to be drawn out in many cases into an elongated spire. There is practically no vestige of the bilateral symmetry traceable in some organs in the Diotocardia even when their shells are spirally coiled as in the Top-shells. The order is an exceedingly large and varied one and includes some 76 families. Many are extremely specialized for life under abnormal conditions; some have adopted a pelagic life on the high seas, swimming or passively floating; others have migrated to the land and to fresh-water pools; a number have become parasites or live as messmates or commensals; they may be carnivorous and even possess poison glands, or they may be vegetarian; some move with considerable celerity, others attach their shells to rocks and simulate the appearance of tube-building worms. Owing to this high specialization it is difficult to arrange their relationship in any reasoned sequence. We can form groups readily seen to possess mutual affinities, but these groups stand apart from others, and it is practically impossible to arrange them in any satisfactory order that will indicate the line of descent or degree of specialization. They represent the terminal twigs of a great branch, and, while they acknowledge a common ancestry, they stand to one another as cousins of varying degree.

Sub-order I.—*TAENIOGLOSSA.*

Fresh-water Snails

If we follow the sequence of Pelseneer, one of the most thorough of authorities upon the mollusca, we take first two families living in fresh-water, the *Viviparidae* and the *Pilidae*. The former is represented in India by the common fresh-water snail, *Viviparus*, so called because it is viviparous—the young develop within the parent and are born as tiny miniatures of the adult and ready at once to begin life independently. The shell is thin and comparatively fragile, covered with thick, olive-green periostracum; the shape is that of a Turbo, hence this form of shell is said to be turbinate, 'coiled like a turban'. It lives in tanks and streams and is occasionally eaten by low-caste people.

Even more common is the larger **Apple-Snail,** *Pila globosa,* formerly known as *Ampullaria globosa.* It grows to a comparatively great size and may even attain two inches in diameter. The shell is nearly globular, with a low spire and a very large mouth opening. In appearance it resembles a big globular *Viviparus*; the two are often found together in ponds and paddy-fields, but *Pila* appears to be the more hardy; it has the advantage over *Viviparus* of having an air-breathing organ or rudimentary lung, in addition to a gill for use under water.

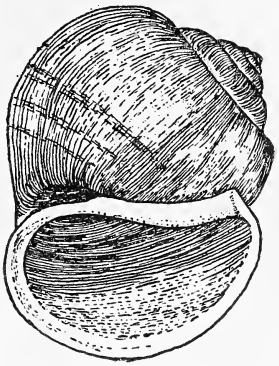

Fig. 3.—Shell of *Pila globosa Swainson.*

This combination enables it to withstand successfully all the vicissitudes of a tropical climate; it enjoys life when the rains flood the fields and it can live in comfort for some time even when out of water; it can also lie hidden in soft mud and still obtain air by pushing upward to the surface of the mud the end of a long muscular tube, which passes air down to the lung chamber. *Pila* is also prepared for the complete drying up of the mud during the dry season; as the water drains away, it withdraws its whole body into the shell, closes the opening behind it with a strong calcareous operculum and remains dormant till the rains come again, when the caked mud enveloping it softens and becomes liquid once more. Its eggs are large and attached together in masses.

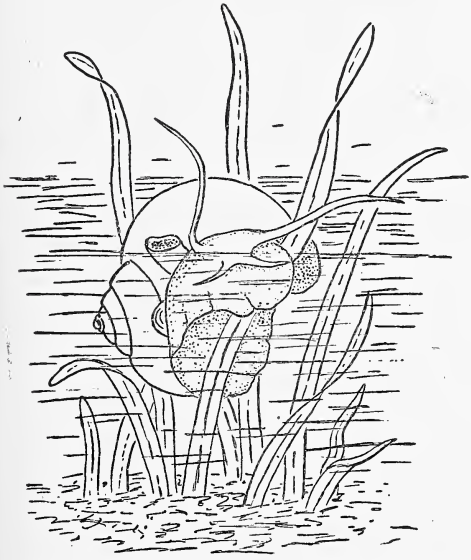

Fig. 4.—Life appearance of *Pila globosa.* $\times\frac{2}{3}$. It has climbed to the surface of the water up the leaves of a water-plant and is inhaling air. Note the large expanse of the foot and the wide inhalant siphon.

In several localities, as in the Tanjore and Tinnevelly districts of South India, the Apple-Snail is regularly collected by poor people who use it to eke out their ordinary meals. It is also used medicinally as an application for sore eyes. In the Philippine Islands it is a regular market commodity.

Periwinkles (*Littorinidae*)

Periwinkles are found on rocky shores in all parts of the world. They have small turbo-like shells but differ from Turbos in having no pearly lining; the operculum is horny. These molluscs appear

to be closely related to the fresh-water snails *Viviparus* and *Pila* for they are able to live a long time out of water especially on coasts where the rise and fall of the tide is great. In some species this sub-aerial habit is so highly developed that individuals may be found living so high on the littoral as to be reached only by sea spray at high tide. In these species the internal surface of the mantle is undergoing modification on the lines seen in the lung chamber of *Pila*; another demonstration is here afforded of how land gastropods have been evolved in the past. It is significant also that the operculated land snails and pond snails (*Viviparidae*) agree with the periwinkles in the arrangement of the teeth on the radula—in each row a broad median tooth is flanked by three somewhat similar ones on each side. In the periwinkles the radula is notably long, the hinder part coiled up like a spare rope in a pocket at one side of the gullet.

In Europe great quantities are used as food, but in India they are put to no useful purpose. They are common on rocky shores on both the Bombay and Madras coasts. An allied Indian genus, *Cremnoconchus*, has entirely abandoned life in the sea; it has taken permanently to the land.

Horn-Shells (*Cerithiidae*).

The next family, that of the **Horn-Shells** or *Cerithiidae*, is another with a marked tendency to migrate from the sea to the

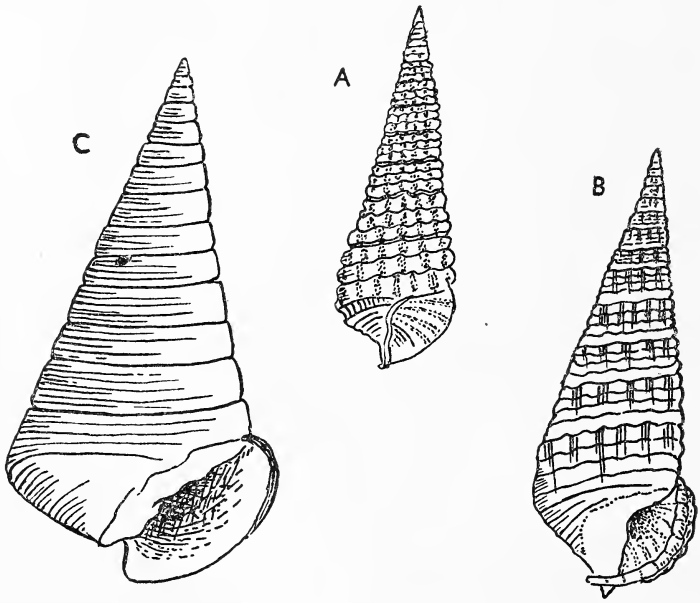

Fig. 5.—Three common Horn Shells. A. *Potamides cingulatus* Gmelin. $\times 1\frac{1}{2}$. B. *Potamides palustris* L. $\times \frac{8}{7}$. C. *Telescopium telescopium L.*

land. All have the apex of the shell drawn out into an elongated spire, simulating the appearance of the true Turret-shell yet to be described, but differing therefrom in having the mouth aperture

widely channelled and with the lip thickened and everted; the whorls are usually ornamented with small tubercles or with varicose ridges marking the position of the lip at different seasonal stages during growth.

The marine species are mostly littoral. *Cerithium obeliscus* is one of the biggest of several common in sheltered bays and saline backwaters. A small species, *Potamides cingulatus* (Fig. 5, A.) is often found in multitudes on mud-flats and at the edge of the tide, playing the part of humble scavengers; lime-kiln women collect them at Tuticorin, to be burned in specially small kilns into the best quality of lime for whitewashing. This species closely resembles *Cerithium* in the ornamentation of the shell and is common in the neighbourhood of Bombay. Two large species, the Horn-shells proper, belonging to the genus *Potamides,* and undoubtedly derived from a species of marine *Cerithium*, are found in abundance crawling in the mud in the mangrove swamps of the Kistna and Godaveri deltas as well as in those of the Konkan coast, more often out of the water than in it. These shells are also used for lime burning. One of them, *Telescopium telescopium* (Fig. 5, C), is easily recognized; it is obviously a large *Cerithium*; the other, often called *Telescopium fuscum*, has a smooth shell without tubercles or ridges. It may grow to four inches in length and village boys in the Godaveri hamlets use it as a spinning top, a feat requiring great skill to perform. In the Philippines the flesh of the Horn-shells is esteemed a wholesome food; the shells are thrown upon wood fires and when sufficiently cooked, the apex of the spire is broken off and the animal sucked out through the broken end. In India, in purely fresh-water conditions, the Horn-shells are replaced by the little *Thiara*, a tuberculated shell much like *Cerithium* but without the deeply channelled aperture characteristic of the latter. *T. tuberculata* is the usual Bombay species.

Worm-Shells (*Vermetidae*).

Peculiarly aberrant in habit are the Worm Shells or *Vermetidae*; in adult life they are always found attached to rocks or embedded in sponges. In early life, however, they are free and their shells are regularly spiral; after they settle down and become sedentary the spiral becomes lax and distorted as it grows in length and may be readily mistaken by the tyro for that of *Serpula*, one of the marine tube-building worms. Having abandoned a roving life a foot for crawling is no longer needed; it is reduced to a mere vestige and serves merely as a support for the strong, horny operculum. Two genera are common in Indian seas, *Vermetus* and *Siliquaria*; the first has an entire tube; the second has a narrow slit or else a

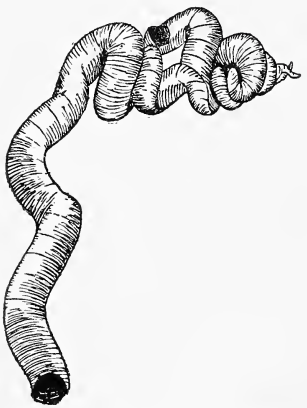

Fig. 6.—The Worm-Shell (*Vermetus*).

series of perforations running along one side for the whole length of the gill chamber. Their respective habitats are distinctive; *Vermetus* cements its tube to rocks and boulders, *Siliquaria* lives commensal with sponges, its coils sunk within the mass of the sponge, to which it gives useful rigidity; probably the presence of the hard tubes of the mollusc affords its host, the sponge, some protection against enemies which otherwise would browse upon it.

As *Vermetus* increases in girth it vacates the hindmost portion of its shell, cutting off the disused portion by means of a transverse partition. This procedure, repeated frequently, gives rise to a series of partitioned chambers at the inner end of the interior of the vermiform shell.

The reefs at extreme low water in the Gulf of Kutch are often so encrusted with the tubes of *Vermetus* that walking barefoot becomes dangerous; they are also found fairly abundant on rocky ground in the Gulf of Mannar, where *Siliquaria* is also common.

The **Screw-Shells** (*Turritellidae*) have elegantly tapered shells of the general appearance of a very elongate and slender Horn-shell. They grow sometimes to a length of four inches. The mouth aperture is thin and simple, without any suggestion of the thickened or everted lip often seen in the Horn-shells. Like *Vermetus,* the Screw-shells find the first whorls of their shell too narrow to accommodate the apex of the body as they grow larger, and have adopted the same habit of partitioning off a narrow, disused portion from time to time. They live in moderate depths in muddy sands. Their shells are cast upon the beach on all our sandy coasts and are often quite common. The only ornamentation consists of spiral ridges; there is never any trace of tubercles or varices. *Turritella duplicata* is a common species everywhere.

The **Wing-Shells** (*Strombidae*) include some of the largest of Indian gastropods; many are most interesting species. The family is an extensive one, with a great range in outward appearance. Three genera are common in Indian waters—*Strombus*, *Lambis* and *Tibia*. The first two have short, conical spires; the outer lip is dilated into a stout wing-like expansion which in *Lambis* is armed with enormously stout finger-like processes.

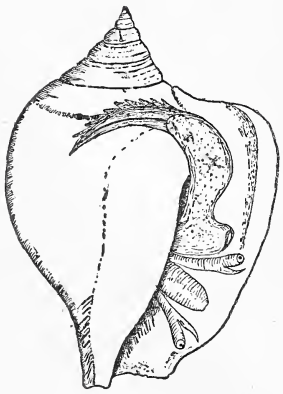

Fig. 7.—The commonest Indian Strombus (*S. canarium* L.). ×1.

The most common *Strombus* in India is *S. canarium*, a small and massive species with a wide wing, strongly thickened along the edge (Fig. 7). It is abundant in the shallows of Palk Bay and the Gulf of Mannar. The poorer coast people collect them when gathering other shells for food and sometimes cook them along with more esteemed shellfish. The shells have value independently of this; very large numbers are used annually at Kilakarai by shell-ring cutters in their trade. These men, who belong to the *Sangu vettian* Muhammadan community, pursue the most primitive of

methods, such as prehistoric men are likely to have employed for the same purpose. The two ends of the shell are first broken down by means of hammer blows, and then the resultant rough-edged middle portion is ground down laboriously upon a stone. Except a hammer, a chisel, and a file to smooth the edges, no other tool is employed. These rings, known as *Sangu modiram,* are extensively used as finger rings throughout the Tamil country as a specific for skin disease. In the Malabar and Kanara districts certain classes of the poorer population—Pulayas, Holayas and some Mukkuvans—use these rings in the making of necklaces for their women and children.

The Stromb is a remarkably active gastropod; its foot is narrow and arched with the hinder part elongated and armed with a peculiarly long, claw-shaped operculum, strongly serrate along one side. The Strombs generally progress by a sort of leaping movement; they are reputed to be carrion feeders and whatever may be their powers of smell, their sight is remarkably acute. Holding one in the hand, the watchful and alert look in the two prominent eyes, each at the tip of a long eye-stalk, is so different from the impression of sluggishness given by most other molluscs, that one has no difficulty in giving the Strombs credit for comparatively high intelligence. Cautious handling is necessary, for they have a deceitful habit of lying quiescent for a few moments, watching an opportunity, and of suddenly wrenching themselves clear with a quick and unexpected jerk, accompanied by a vicious lash of the saw-like opercular claw; a nasty wound can be made by this weapon in the case of the larger species.

Strombus gibberulus, S. lentiginosus and *S. auris-dianae* are species found in the Laccadive Islands; the first is common around Bombay.

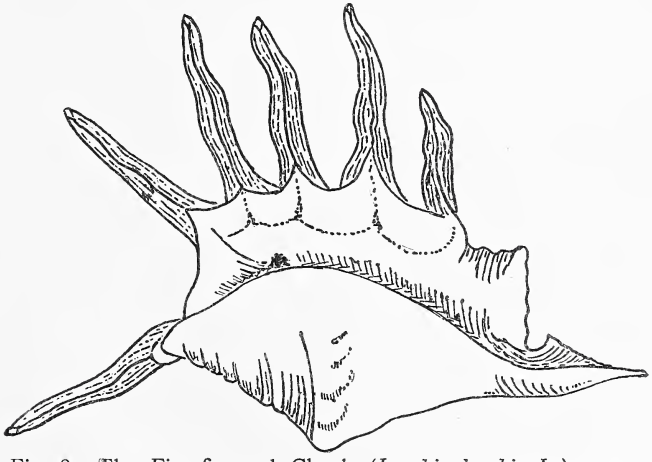

Fig. 8.—The Five-fingered Chank (*Lambis lambis* L.). ×1.

The Scorpion-shell or Five-fingered Chank, *Lambis lambis,* is the most common species of its genus in Indian waters (Fig. 8). It is found on both coasts but in the faunistically rich weedy shallows

of Palk Bay it is extraordinarily abundant. The size when fully grown is considerable; a length of seven inches is quite common, while the width, if we include the long oral 'fingers', is fully half this measure. In the immature condition the shell looks like an ordinary Stromb; only when it begins to assume adult form does it commence to put forth the great fingers which are so characteristic. In the immature condition these are channelled on the ventral side, processes of the mantle lining the channels; with approach to the adult form when further growth is arrested, the channels close and the fingers become solid (Fig. 9).

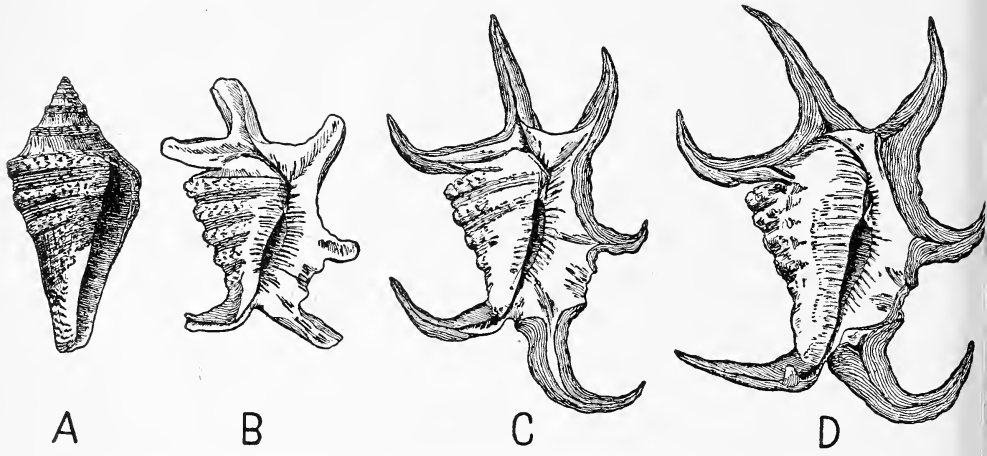

Fig. 9.—Growth changes in the shell of *Lambis chiragra* L. In the younger stages no 'fingers' are present. They appear later as wide, channelled projections.

From low water to a depth of two fathoms this shell is often numerous on weedy bottom, in Palk Bay. Some are collected by shore people by wading in at low tide, but the great majority are taken either by bêche-de-mer divers or accidentally in nets set for crabs; of these nets many miles' length are shot daily during the season. The shells serve a variety of purposes; for food they are broken open and the flesh extracted; as net sinkers they have the fingers broken off, the shells perforated and then tied at intervals along the ground rope of nets; by burning, whitewash lime is made; lastly, they are used as traps for octopus. To fit them for the last named use, the apex of each shell is broken off together with the fingers, and each is then tied at the end of short line which in turn is made fast to a main rope. These branch lines are attached at intervals of 5 or 6 feet; as many as 30 shells may be tied to one rope. For use a number of ropes are strung end to end and laid in shallow water overnight; when raised the next morning a number of small octopus are found sheltering in the cavities of some of the shells. These are used as bait when the fishermen go lining for such fish as seer, parai, dogfish and rays. Hundreds of such shell-trap bait-lines are in daily use on the Ramnad coast from Devipatam northwards. In Japan and in Italy a device on the same principle is employed for a similar purpose;

is place of *Lambis* shells the Japanese and Italians use narrow-necked vase-shaped earthenware pots, tied by the neck to the main line.

Several other species of *Lambis* are found in our seas, notably the grotesque *L. chiragra*, common in the Laccadive Islands. In this shell the aperture is armed with six crooked fingers so irregularly twisted as to impart a deformed appearance to the shell (Fig. 9).

Beak-Shells (*Tibia*).

The third Indian genus of the Strombs is *Tibia*, comprising the Beak-Shells. In these the shell has a finitely tapered spiral form, smooth and brown; the mouth whorl expands into a wide wing armed with several short and stout spines along the margin and with the anterior end prolonged into a slender, semi-tubular rostrum or beak. *Tibia curta* is rare in the Gulf of Mannar but off the Bombay and Malabar coasts it is often abundant in depths between 10 and 30 fathoms (Fig. 10).

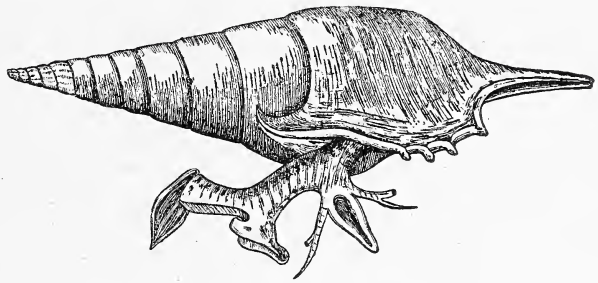

Fig. 10.—Living appearance of *Tibia curta* Sowerby. From 25 fathoms, off Malabar. $\times\frac{2}{3}$.

Closely related but very different in outward form is *Xenophora*, a shell not uncommon in deep water in company with *Tibia*, off the West Coast. Its form is trochiform ('like a *Trochus*') but more depressed and wider in proportion and rather fragile. The animal is very like a Stromb but with the eyes near the base of the slender tentacles instead of being at the summit of long eye-stalks; the foot is even more conspicuously divided into two parts and equally obviously intended for scrambling over the ground at a rapid rate. The operculum is fan-shaped and prettily sculptured with radiating lines. These molluscs are remarkable for the characteristic way they have of disguising themselves by cementing small dead shells to the upper whorls of the spire—the last whorl in adult shells is usually without this decoration. This masking device is intended to deceive possible enemies; the trick must be effective for *Xenophora* is common at its own particular horizon—a depth of 12 to 30 fathoms—in spite of its shell being thin and easily crushed. In one species the margin of the whorls is beautifully stellate; in others it is thin and foliaceous. On account of the singular habit of collecting shells to conceal their habitations, the *Xenophoridae* have sometimes been termed 'Conchologists'; those that use fragments of stone being 'Mineralogists'! They are usually found on level muddy bottom where the surface is strewn with dead and broken shells.

False-Limpets

Of habit wholly different are the two families of False-Limpets, *Capulidae* and *Calyptraeidae*. The former includes the Bonnet. Limpets (*Capulus* and *Amathina*). *Capulus* has a conical shell not unlike the Cap of Liberty, the apex slightly recurved. In Indian waters the common species is *Amathina tricostata,* a small shell with the apex toward the hinder end and without any trace of the recurved point seen in *Capulus*. Three stout ribs pass from the apex to the anterior margin, rendering identification easy. It seldom grows to more than an inch in length and is generally found attached to the valves of pearl-oysters on muddy sand in five to six fathoms in Palk Bay; on the cleaner bottom of the pearl-banks in the Gulf of Mannar this mollusc is absent.

Another interesting Indian Capulid is the little *Thyca ectoconcha,* parasitic on the under side of the long arms of the starfish *Linckia*. A muscular plate grips the surface of the starfish and through a hole in this the pharynx of the parasite works its way into the tissues of its host.

Cup-and-Saucer Limpets and Slipper-Limpets

The *Calyptraeidae* include the Cup-and-Saucer Limpets (*Calyptraea*) and the Slipper-Limpets (*Crepidula*). The former are small and conical, the latter, as their English name implies, oval and much flattened. In both an internal plate or shelf occurs, the remains of the original spire of the shell. In *Calyptraea* this plate has a half-cup shape, whence has come its popular name. These small shells are not uncommon in fairly shallow water; on hard bottom *C. pellucida* usually adheres to stones; where it is muddy, to any shells that manage to survive there, particularly to the Window-pane Oyster (*Placenta placenta*), common in muddy bays and inlets in Sind, the Gulf of Kutch and the Bombay coast. The exterior of the shell is rough and irregular and always white, in marked contrast to the pale yellow tint of the body within.

The shape of the Slipper-Limpets (*Crepidula*) is well expressed by the name—a long oval, much flattened, with a shelf-like projection within across the posterior half, exactly like the toe end of a slipper. They show a remarkable resemblance in the form of the shell to *Septaria,* the fresh-water Nerite; the internal ledge is, however, not the remains of the lip of the columella but a purchase for the attachment of the adductor muscles.

Under favourable conditions Slipper-Limpets may increase so prodigiously as to become a danger to the prosperity of the edible oyster industry. An example of this is the damage done to valuable oyster beds on the east coast of England by the American Slipper-Limpet (*Crepidula fornicata*), imported inadvertently with a consignment of oysters from the United States. The intruder found conditions so favourable that now a dredge sometimes brings up as many slipper-limpets as oysters; their consumption of the available food is so great that the oysters, which live on the same organisms as the limpets, have insufficient food and do not fatten and thrive as they should.

The *Naticidae* are active, sand-burrowing molluscs. In the genus *Natica* the shell is strong, handsome and highly polished, usually

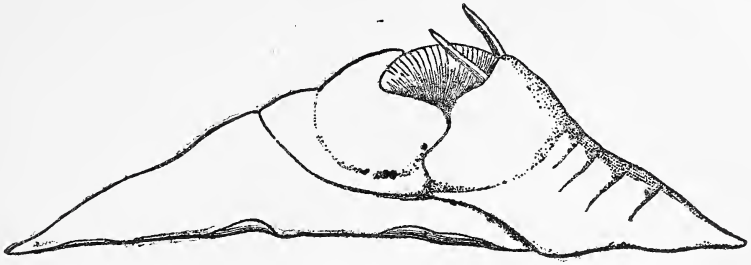

Fig. 11.—Life appearance of *Natica*, showing the shell sunk within the lobes of the foot. ×¾.

almost globular but in some cases with a mouth whorl so expanded as to appear roughly ear-shaped. The whorls are few, the spire small and obtuse. The columella is often much thickened. Naticas are predaceous in habit and exceedingly voracious. The foot is enormously enlarged, and developed within it is a system of water canals that enables it to burrow with remarkable celerity—a most ingenious hydraulic mechanism; being carnivorous this facility of being able to drive plough-like through sand is of immense importance to the animal in its search for the molluscs upon which it feeds. Lobes of the foot rise over the shell before and behind and completely enfold it, protecting it from abrasion (Fig. 11). As the burrowing habit renders sight valueless, we find eyes in the Naticas either absent or buried in the integument.

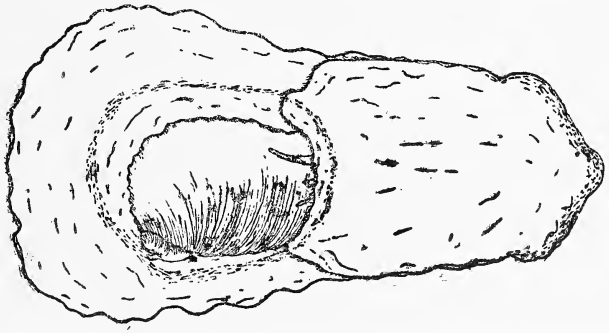

Fig. 12.—View from above of *Natica* seen crawling. ×¾. The shell and the lobes are pure white in colour save for the yellowish anterior margin of the propodium.

The black-mouthed *Natica melanostoma* and the snowy white *N. mammilla* are two Indian species abundant on sandy shores where they live upon the burrowing bivalves that abound there. Having found a shell, *Natica* seizes it and settles down to bore a hole through one of the valves. This it performs neatly and much more quickly than one would think possible. When completed, the long

retractile proboscis is inserted through the aperture and the flesh of the victim eaten out. The peculiar egg-mass of *Natica* in the form of a broad spiral sandy ribbon is quite common during the breeding season on sand flats and in shallows at the mouths of our rivers. The eggs are minute and so mixed and agglutinated with sand grains that few people ever suspect that these sandy ribbons, looking like rolls of coarse sandpaper, enclose thousands of eggs of a little gastropod (Fig. 13).

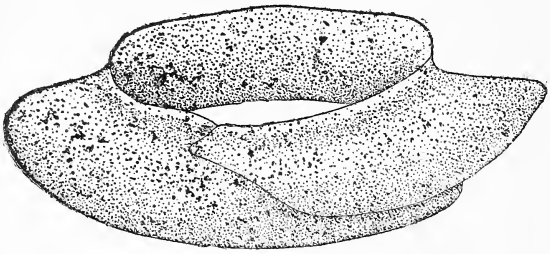

Fig. 13.—Egg-ribbon of *Natica*. ×1.

A less common Indian genus is *Sigaretus*. Here the foot is even more greatly developed than in *Natica*, particularly at the fore end where it assumes the form and function of a ploughshare to push the sand away on both sides as it burrows. In these molluscs the shell is ear-shaped with a very wide aperture; the operculum is minute and of no protective value to its owner.

Violet Snails

Here for convenience are usually placed the Violet-snails (*Ianthinidae*) although they do not fit in any more satisfactorily than in any other of the kindred sub-orders of the Pectinibranchs, for the teeth on the radula are pointed and neither pectinate, serrate nor pronged; neither is there a central or rhachidian tooth. Their habit is characteristic; they are purely pelagic, floating at the mercy of the currents in all warm seas. Particularly common in the Indian Ocean, their beautiful violet-tinted snail-shaped shells, thin and fragile, are often thrown up on our beaches after long continued onshore winds. Sometimes they are cast ashore alive and if we put one into a bowl of sea water we see how cleverly they have overcome the difficulty of keeping afloat. Under natural conditions they float with the spire of the shell downwards; to the hinder end of the small upturned foot is attached a long, tongue-shaped frothy float, composed of a multitude of air-bubbles entangled in a transparent secretion of the foot (Fig. 15). Each bubble is formed separately by the foot and added to the near end of the float; the secretion forming the envelope of the bubble coagulates on contact with the water and hardens into a delicate but tough membrane.

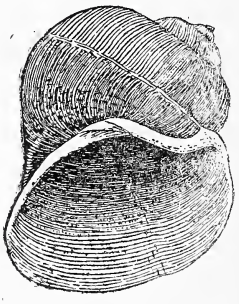

Fig. 14.—Shell of *Ianthina roseola* Reeve. ×1.

Strangely enough in animals that lead a free life, eyes are absent. Neither have they any operculum. Several species are found in Indian seas.

Ianthinids are gregarious and float about in shoals, feeding upon oceanic Jellyfishes (Siphonophores), usually tinted violet like themselves. The females of some species attach their egg-capsules to the under side of the float; others bring forth their young alive.

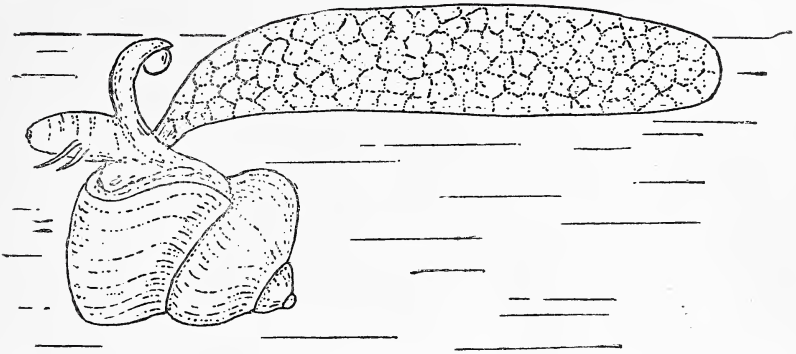

Fig. 15.—Living appearance of *Ianthina* with its frothy float attached to the foot. A freshly formed 'bubble' is held in the curved tip of the foot, ready to be added to the float. ×1

The Wentle-Traps

The Wentle-Traps (*Epitonium* spp.) are closely allied. They have a superficial resemblance to *Turritella*, from which the shells are distinguished by the closely set ribs or varices ornamenting all the whorls.

Fig. 16.—A Wentle-trap Shell (*Epitonium*).

The Cowries

The Cowries (*Cypraeidae*) are amongst the best known of Indian molluscs; the beauty and the variety of the colouring of their splendidly polished shells render them conspicuous and valuable. The adult shell differs in form from any other; to understand its structure we must examine the stages by which it changes from the immature condition to the perfect shell. The young form is elongated, with a prominent conical spire, and a long wide mouth aperture bounded by a thin, sharp outer lip. A delicate periostracum covers the surface. As the animal approaches maturity, the mantle flap from each side expands and becomes reflected over the back of the shell, the edges meeting a little to one side. The periostracum becomes absorbed and in its place the inner surface of the mantle lobes deposits a highly polished enamel of variegated colouring upon the shell; this deposit extends over the spire as well and ends by obliterating and concealing its coils. A line, usually of paler colour, down the back indicates where the mantle lobes meet. Coincident with this, the outer lip turns inwards, thickens and assumes the furrowed appearance so characteristic of the lip in adult cowries; the edge of the columella or inner lip also thickens and assumes a similarly furrowed appearance. In the end the aperture becomes quite nar-

row, with a well-marked short canal at each end. The mantle and foot are even more vividly coloured than the shell and few objects are more beautiful than a large cowry crawling in a coral reef pool, the mantle bright with scarlet and yellow and beset with gracefully branched filaments. The foot is without an operculum; though large it can be retracted, together with the great mantle lobes, wholly within the shell. Cowries live on rocky ground, particularly in and about coral reefs. They are often found hiding under boulders at low tide and appear limited to shallow water.

Fig. 17.—*Cypraea annulus* L., a species closely related to the Money Cowry.

The little Money Cowry (*Cypraea moneta*) is abundant on the reefs near Pamban at the western end of Adam's Bridge, where it attains a larger size than those brought from the Maldive Islands in the course of trade; the Indian variety is distinctly more intense in colouring, being a dark yellow. Even yet these cowries are employed as small change in country bazaars and enormous quantities are in circulation in West Africa. In India it is esteemed as an ornament and as an amulet to avert the effects of the evil eye; the lore of the money cowry in India alone would fill a bulky volume.

Another small species common on rocky ground and on coral reefs is the Eyed Cowry (*C. ocellata*), the back dotted with tiny greenish spots ringed round with yellow, the ocelli. Larger species comprise the Tiger Cowry (*C. tigris*) covered with large, bordered spots; the Black Cowry (*C. mauritiana*), a most handsome and elegant form; the Mole Cowry (*C. talpa*); the Serpent's-head Cowry (*C. caput-serpentis*), the Arabian Cowry (*C. arabica*) and several others less well known. The Laccadive Islands are particularly rich in species of this genus. At least seven species are found in the Bombay area.

Egg Cowries

In the Amphiperatidae, only the outer lip is furrowed or crenulated, the columella remaining smooth and rounded. The best known is the big Egg Cowry (*Amphiperas ovum*) used in New Guinea and the islands to the east as a personal ornament and as a decoration of everything the natives value. It is snow white and is a striking ornament when a number are worn as a fillet bound round the forehead.

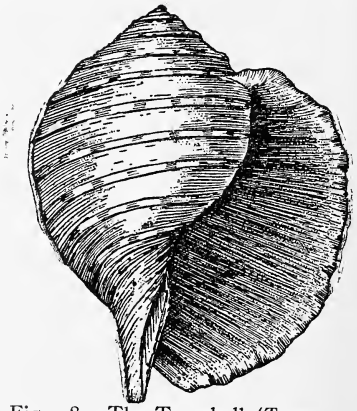

Fig. 18.—The Tun-shell (*Tonna dolium* L.). ×½.

Smaller forms, the Ovulas, are common in Indian seas living as commensals with the Sea-fans (Gorgonids). These Sea-fans are usually brown, yellow or red and the little Ovulas (*Primovula frumentum*) always agree in colour with their host's hue; a yellow Ovula is never found on a red Gorgonid nor a red Ovula on a

yellow Gorgonid. The colour of the mollusc resides in the mantle only; the shell is not coloured. Even more beautiful is a species of cowry living upon the cauliflower-like *Spongodes,* one of the soft corals. In this case the host is either pink or orange in general colour, but this is confined mainly to the terminal parts of the branches bearing polyps; the main stem and the main branches are generally white. Hence the little cowry that lives there has the mantle blotched yellow or red as the case may be; this harmonizes with the general colour of the host much better than if the mollusc were self-coloured. The foot is narrow and admirably adapted for climbing along the round branches of its host. In size these little commensal cowries seldom exceed an inch in length.

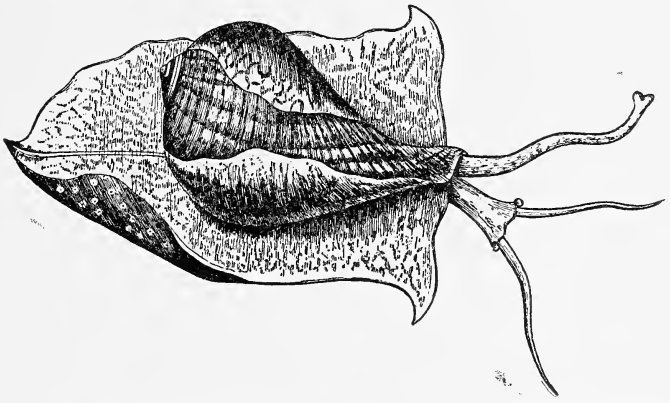

Fig. 19.—Life appearance of *Pyrula ficus* L. ; note the large flattened foot and the mantle folds enwrapping the shell. (After Owen.)

They are active in habit and get about nearly as quickly as the red or yellow spotted commensal crabs that have the same protective colouring and live the same kind of life among the branches of the *Spongodes* host. The reefs in the Gulf of Kutch, around the Laccadive Islands and in the Gulf of Mannar are their chief habitats in India.

Triton-Shells

None of the large species used as shell-trumpets in Polynesia and the Mediterranean is seen in Indian waters except in the Laccadives; their place for this purpose is commonly taken by the Chank or Sankha (*Xancus pyrum*). Species found in the Laccadives are *Cymatium tuberosum* and *C. lotorium.*

Small related forms belonging to the genus *Bursa* are, however, common on the mainland coast as well as in the Laccadives. These shells, commonly known as Frog-shells, are short and with a stout strengthening ridge or varix continuous along the whole length of each side; each varix in each whorl represents a seasonal arrest of growth accompanied by a thickening of the lip. The intervening space is tuberculated; the lip corrugated. These molluscs live in shallow water on rough bottom and well deserve

their common name for they have an absurd likeness to tiny tree-frogs squatting head up, ready for a leap. *Bursa foliata* and *B.*

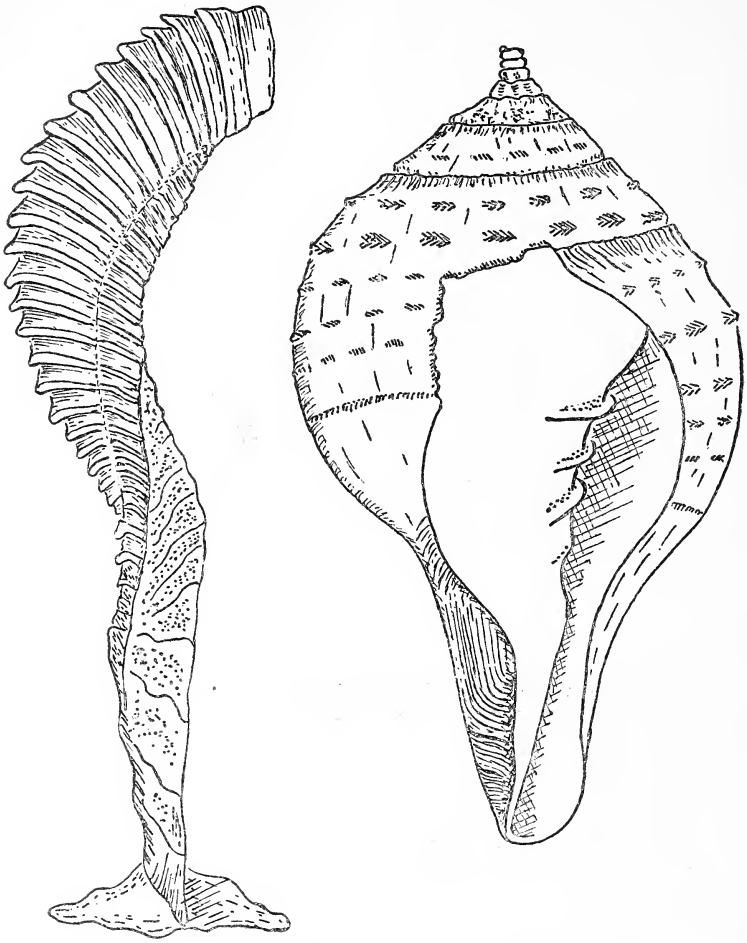

Fig. 20.—The Sacred Chank, *Xancus pyrum* L. with its egg capsule. ×½.

granularis are common species on the mainland coast, with *B. bufonia* and *B. rubeta* also in the Laccadives. They serve as useful scavengers, swarming in crowds upon dead fish thrown ashore.

The larger **Helmet shells** (*Cassididae*) are represented in India by two species, the Great Helmet-shell, *Cassis cornuta,* and the Red Helmet, *Cassis rufa.* The former is the largest and heaviest of Indian gastropods, its shell weighing several pounds. In shape it is not unlike a monstrous knobbed Strombus but with the outer lip much thickened and the inner one expanded horizontally over the columellar region of the body whorl to form a flat polished surface in the fully grown condition. These great shells are rare and are usually found at a depth of eight to ten fathoms on the pearl banks in the Gulf of Mannar and in the same depth in the neighbourhood

of the Laccadives. The smaller species, *C. rufa,* growing to about six inches in length, is a Laccadive species. It is of a reddish tint with the prominent spines seen in *C. cornuta* here represented by low blunt knobs. *C. canaliculata* is a common shore species of small size.

The shell substance of the large Helmet-shells consists of differently coloured layers, a peculiarity taken advantage of by the cameo-workers of Naples and Torre del Greco, who employ *Cassis rufa* for cameos requiring a dark ground. Other species give a purplish blue ground, the carved figure appearing in white relief.

The *Tonnidae* are familiar objects thrown ashore on all sandy beaches on Indian coasts. All these shells have a widely expanded (*ventricose*) body whorl with quite a short spire. Two genera are common, *Tonna,* the **Tun-Shell** (Fig. 18) and *Pyrula,* the Fig-shell. *Tonna* is remarkable for its globose form and the many narrow ribs that revolve round the shell from mouth to apex. It is fragile but so light and so round that dead shells seldom get damaged when they drift ashore. Four species are recognized as Indian—*Tonna maculata, T. olearia, T. pomum* and *T. perdix.*

The Fig-shells (*Pyrula*) are so named because of their shape. Their habits are the same as those of the Tun-shells—they live on sandy bottom not far below low-tide mark; to enable them to crawl rapidly and comfortably over soft, unstable sand, the foot in both is very wide, forming a broad flat sole. In *Pyrula* (Fig. 19) this is particularly wide and both the upper surface of this foot and the mantle folds that more or less enwrap the back of the shell as in the cowries, are beautifully veined. (In the case of *Tonna* the dorsal folds are not present).

Dead examples of the **Staircase-Shell,** *Architectonica,* are fairly common on sandy beaches around our coasts after storms. The shell has a handsome low spiral form and is not unlike *Xenophora* in general appearance; in outline it is orbicular when viewed from above, the last whorl angular at the outer edge; a deep pit or umbilicus passes down the centre of the columella opening on the under side of the shell. The projecting inner edges of the whorls seen on the sides of the umbilicus have been fancifully compared to the windings of a spiral staircase.

A strange peculiarity of *Architectonica* is that the embryonic shell is sinistral but in the course of growth becomes inverted and hidden under the succeeding whorls, all except the base.

Sub-order II.—*STENOGLOSSA.*

Tribe 1.—**Rhachiglossa**

The gastropods in this group are all marine, with a long extensile proboscis and a long radula armed with three teeth in each of many rows, one central or rhachidial and one lateral on each side. They deposit their eggs in horny capsules.

Of the various families represented, the *Turbinellidae* is the one of special interest in India for a member of the type genus *Turbinella* (now unfortunately renamed *Xancus* by an overstrict adherence to certain rules of nomenclature) is the Sankha or Chank, a shell around which has gathered more legend and folk-lore than around

any other in the world. Other important genera in this family are *Cynodonta* and *Melongena*.

Chank

The (*Xancus* [*Turbinella*] *pyrum*) is a species strictly confined to Indian waters, occurring nowhere else in Asia. There are several local varieties or sub-species; these appear to have originated when numbers of the parent type became separated from the main body of the species and exposed to changed environment conditions.

The central or type form, found only in the Gulf of Mannar and on the Kathiawar coast, is distinctly fusiform or spindle-shaped, with a handsome, well-balanced spire (Fig. 20). The mouth is wide and is prolonged anteriorly into a long, deep canal lodging the great siphon used in sensing the presence of the worms on which it feeds. The columella bears three or sometimes four strong ridges to which the very strong columellar retractor muscles are attached. Individuals living in shallow water, where they are exposed to the influence of strong currents during the south-west monsoon, have these ridges particularly strong and prominent in order to afford increased purchase to the muscles connecting the foot with the shell. The exterior is covered with a thick velvety coating of golden-brown periostracum, completely hiding the snowy white porcellaneous shell beneath.

The chank is gregarious and its haunts form distinct beds. It prefers a sandy bottom where tube worms abound; these constitute its chief food. The most prolific beds occur in depths of 8 to 10 fathoms in the Gulf of Mannar; in Palk Bay to the north of Adam's Bridge the local race or variety *rapa* (*X. pyrum* var. *rapa*) occurs in beds at a lesser depth in sand much mixed with mud; this environment has resulted in the formation of a race showing signs of retarded growth, the most obvious being a reduction in the height of the spire. In the Andamans a race is found so distinctive in its characters that it is desirable to consider it as a separate species (*Xancus fusus*). The anterior canal is much elongated and distinct remains of knobs are present along the shoulders of the whorls, an ancestral feature all but obliterated in the chanks of the mainland waters.

The larval development of the chank is typical of that of many of the gastropods of this group, and is almost identical with that of the European whelk (*Buccinum*). The ova are deposited in a many-chambered stiff parchment-like egg-capsule of striking appearance. The general form is an elongated, loosely spiral annulated cylinder, each annulation representing one capsule unit; the whole looks like a miniature ram's horn, corrugated and twisted, set point downward in the sand (Fig. 20). When newly formed it is pale opaque yellow in colour; with age it darkens and becomes covered with low growths of algae. It stands upright on the sea bottom; the lower and first formed end rooted in the sand by means of a broad, flange-shaped anchoring disc. The lower end is narrow and neck-like, the chambers small; these gradually increase in size as they ascend till at a point about one half of the length from the base they attain maximum size which is thence

maintained to the abruptly truncate summit. The total height is from 7 to 10 inches.

This case is a compound capsule consisting of a number, 25 to 30 or even more, of discoidal capsules attached at one point to the edge of a broad basement band that runs along one side of the case from base to summit (Fig. 20). Without this knowledge it would be difficult to understand the complicated structure. The various capsules are closely set, the roof of one practically touching the floor of the one above. In the floor of each capsule is a crescentic slit parallel with the front edge, hence when the case sways to the current, the partition walls of the individual capsules gape slightly and so allow a circulation of sea-water to provide the aeration needed by the larvae. The horizontal partitions are much thinner than the outer wall.

In each chamber or capsule a considerable number of fertilized ova are deposited, embedded in a transparent, colourless, albuminous nutritive jelly, completely filling the interior. In this matrix the embryos go quickly through the trochosphere stage and then assume a modified veliger form characterized by the possession of a spiral larval shell. This is quite different from that of the adult and is distinguished by the term *protoconch*. When fully developed it reaches a length of about a quarter of an inch; the whorls are all nearly the same diameter, so that it appears as a cylindrical coil of about $2\frac{1}{2}$ to 3 turns. During the earlier larval period fratricidal war occurs among the brood, ending in the disappearance of the weaker among them, till only some half dozen remain alive to complete their development within each chamber. The change to the immature semblance of the adult takes place suddenly; there is no gradation from the cylindrical form of the protoconch into that of the young adult form marked by the expansion of the mouth whorl, an expansion that widens continuously to keep pace with the rapid increase in size of the young chank. Differences of colour and surface also take place; from the white, smooth surface of the protoconch, the newer part of the shell becomes brown-flecked, with a distinctly angular shoulder bearing low knobs.

By the time the young chanks attain a length of rather over half an inch, all the nutritive contents of the capsule have been exhausted; this and the fact that they are no longer able to devour one another because of the increased stoutness of their shell combine to compel the ravenous young to leave home in search of food. Their first step is to eat through the partitions dividing the separate chambers, a proceeding which results in the bringing together of the whole surviving family, numbering usually from 200 to 250 in all. The stronger next either eat a way through the outer wall or force their way out between the capsules. The whole brood follow, to scatter over the adjacent sea bottom to lead independent lives. It is noteworthy that in the chank, the protoconch persists through life, accidents excepted, at the apex of the shell.

The breeding season when the capsules are fashioned and rooted in the sand, extends throughout January, February and the first half of March. The sexes are separate.

The chank is an excellent instance of the acquisition through natural selection of characters which appear, for all practical purposes, absolutely perfect to enable it to hold its own with ease in its struggle for existence. The massive strength of its shell protects it from the attacks of all ordinary fishes; the density and thickness of its periostracum give, during youth and maturity, adequate protection against the insidious attacks of the boring sponge *Cliona* and its shell-tunnelling congeners; the strong capsule which it constructs for its young gives them protection till they reach a self-supporting stage, endowed even at this early period with a fairly strong and resistant shell. Its semi-burrowing habit gives it defence against those fishes which are accustomed to snap off the protruded feet of gastropods.

As chanks grow old their resisting powers diminish and the protecting periostracum receives damage, thereby permitting the burrowing *Cliona* to obtain a lodgement in the shell substance. Once there it speedily runs its branching tunnels everywhere, converting the solid shell into a honeycombed mass.

The chank fisheries of India and Ceylon produce on an average over 2,000,000 shells per annum. In some years the number may rise to about three millions but of these the greater number are 'dead' or sub-fossil shells dug out of the mud of the Jaffna lagoons in Ceylon where they have lain for hundreds of years, covered in an ever increasing deposit of silt.

The bulk of the shells fished are exported to Bengal where they are sawn and carved into bangles used universally in that province by Hindu women of all castes. In the Tamil districts of Madras great numbers of small ones are used as amulets to protect against the evil eye, especially in respect of draught bullocks and cows in milk.

Among the chanks fished each year are usually a few sinistral or left-handed examples in which the whorls of the shell instead of twisting clockwise from left to right when the shell is held with its mouth or anterior end pointing forwards, are reversed and twist from left to right. On account of their rarity these abnormal shells are accounted by Hindus and Buddhists of great religious value. A sinistral chank is one of the emblems of Vishnu and such shells are amongst the most important of the treasures of the great Hindu temples. In Tibet the Lamaistic monasteries treasure similar objects, gorgeously mounted in silver, richly embossed. At one time the value of sinistral chanks is said to have been assessed at their weight in gold. Good shells are still assessed by weight, the price per tola increasing greatly as the shell becomes heavier.[1]

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[1] For works dealing exhaustively with the Sacred Chank, consult the following :—

Hornell, J., 'The Chank Bangle Industry: its Antiquity and present Condition', *Memoirs of the Asiatic Society of Bengal,* Vol. III, pp. 407-448, 4 pl. Calcutta, 1913.

Hornell, J., 'The Indian Varieties and Races of the Genus *Turbinella*', *Memoirs of the Indian Museum,* vol. vi, pp. 111-122, with 12 plates and 4 figs. Calcutta, 1916.

Dog Chanks

A near relative of the Sacred Chank is the **Dog-Chank**, *Vasum (Cynodonta) cornigerum,* a strong, murex-like shell covered with stout knobs; like the true chank strong ridges are present on the columella. It is found on rocky ground, rarely in the Gulf of Mannar, more frequently in the Laccadive Islands.

Melongena vespertilio is common at the mouths of backwaters. It has a distinct resemblance to the Andaman chank, having a well-marked shoulder from which short conical knobs project at regular intervals. The spire is short and the canal long. The surface is covered with a velvety, yellowish-brown periostracum. There are no plicae on the columella.

Knobbed Chanks

The Knobbed Chanks, *Fasciolariidae,* often grow to a great size, particularly *Fusus (Hemifusus) colosseus* which reaches a length of about 14 inches. In India the largest common species is the *Fasciolaria trapezium*, a chank-like shell, often four inches long with a short spire armed with stout knobs. The columella lip anteriorly is ridged into several oblique folds. A thick brown periostracum protects the shell. It lives on the same ground as the true chank but in comparison is much scarcer. The eggs are laid in numerous small vase-shaped capsules.

A smaller species is the dark brown *F. filamentosa*, with sculpturing reduced to faint spiral ribbing and the merest vestige of knobbing on the shoulder.

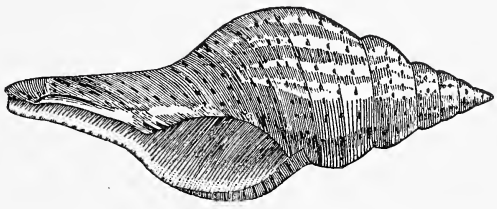

Fig. 21.—Shell of a typical *Fasciolaria*. ×⅔.

Much more elegant is our Spindle-Shell, *Fusinus colus*. No shell could be named more appropriately for it is typically fusiform or spindle-shaped, the spire drawn out very long and the canal extremely long and narrow. The body whorl is comparatively small; the well-defined angular shoulder to the whorls is beset with wide rounded ridges.

The genus *Latirus* is also represented in Indian waters; its species are small and less well-known than other members of the Fasciolariidae. *L. craticulatus* and *L. smaragdulus* are recorded from the Laccadives and probably occur on the Bombay coast. Both *Fasciolaria* and *Latirus* are distinguished by oblique plicae on the columella, a feature absent in *Fusinus*.

Mitre-Shells

The Mitre-Shells (*Mitridae*) are handsome, brightly coloured shells, much sought after by collectors. Unfortunately the finer

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Hornell, J., 'The Indian Conch (*Turbinella pyrum*) and its Relation to Hindu Life and Religion', *Report to the Government of Baroda on the Mar. Zoology of Okhamandel in Kathiawar,* vol. ii, pp. 1-78, with 7 plates and 2 text-figs. London, 1916.

species are rare in Indian waters. The commonest is the Bishop's **Mitre** (*Mitra episcopalis*) found on sand stretches in sheltered bays; it is a particularly beautiful shell, the shape that of a stoutly elongate spindle with the surface ornamented with spiral rows of blotches and spots of bright scarlet. The mouth is rather narrow and like that of the chank is distinguished by the presence of several pleats or folds on the columellar lip. It is a sluggish creature, burying itself in the sand when not on the prowl for food.

The Mitres are almost exclusively confined to the waters of warm latitudes.

Whelks

The next family, the Whelks or *Buccinidae*, conversely to the Mitres, are characteristically northern in their habitat so far as regards their most typical and common genera.

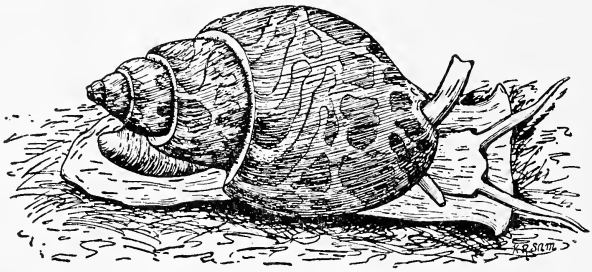

Fig. 22.—*Babylonia spirata* L., crawling over sand.

The only conspicuous Indian genus is *Babylonia*. Its species are stout whelk-like shells, solid and smooth, the white shell usually spotted or blotched with red, obscured during life by a thin dirty brownish periostracum. A very characteristic feature is the rectangular form of the suture dividing the whorls. In the young an umbilicus is present; with age the inner lip becomes thickened and eventually spreads over the umbilical opening.

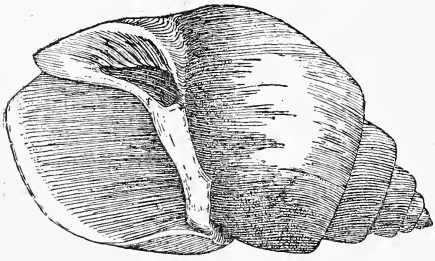

Fig. 23.—Oral view of shell of *Babylonia spirata* L.

The common Indian species are *Babylonia spirata* and *B. zeylanica*; neither has any economic value, but a whelk of an allied genus, *Pollia* (*P. spiralis*), is a minor sea product collected for food on the Konkan coast.

Neptunea antiqua is an extremely abundant species in Western Europe; apart from its considerable value as food, a point of great interest is that a separate race or variety arose in Pliocene times distinguished by its reversed or sinistral twist. In the Indian chank this abnormal form is extremely rare but even here the majority occur in one restricted locality, indicating that there is in this place a family (using the word in the limited popular sense) distinguished by this

peculiarity, just as there are occasionally families among men where six fingers are commonly inherited instead of the normal five. In Pliocene days such a family of *Neptunea antiqua* evidently competed successfully with their normally shaped relatives and established a race that became temporarily dominant; to-day this sinistral variety still survives on the coast of Spain, but on the British coasts the normal (dextral) form has regained its original dominance and has ousted almost completely the abnormal sinistral variety.

Dog Whelks

The family of the Dog-Whelks (*Nassariidae*) are all small and often tiny shells of the outline of the chank in miniature, usually covered with many rows of tiny tubercles; the mouth aperture is constricted, with the outer lip thickened and often armed with prominent 'teeth' as may also be the inner lip formed by the growth of a strong callous deposited upon the end of the columella. The foot is long and broad and sometimes bifurcated behind. The siphon is long and conspicuous. The Nassariids are in the main scavengers, living upon carrion; their sense of smell is extremely acute and they may be trapped in numbers by laying down a dead crab or a piece of decaying meat in shallows or in a rock pool. If Nassariids abound it will not be long before they are seen trooping from all sides, each with its siphon extended in front, waving enquiringly from side to side, trying to locate the source of the odour they smell. They cluster round and over a dead mollusc or a dead crab exactly as ants do over a dead insect that they have found, but instead of dragging it away to their nest as ants would do, the Nassariids devour their find there and then. They are great enemies of small bivalve molluscs, seeking them out by burrowing through the sand.

Common Indian species are *Nassarius papillosus, N. monile* and *Arcularia australis* and *A. thersites,* all found in shallow water, often between tide-marks.

Murices

The family of the *Muricidae* has a world-wide distribution; tropical species are numerous and include many very handsome and peculiar forms, ornamented in many instances with prominent growth ridges (varices) fantastically armed with thickly set spines (Fig. 24). The shells are stoutly built, variable in form—sometimes fusiform, but more often with a shortened spire and wide body whorl. In many species the anterior canal is very long and narrow, with sides so incurved as to become almost closed and tubular; a posterior canal is absent. The foot is cut off abruptly in front. The proboscis is long and retractile, armed with a long and narrow radula having three teeth in each transverse row; the central tooth has three short spines and several denticles, while each lateral one is simple and talon-shaped. With this armature the mollusc is able to bore circular holes in other shells in a manner similar to that employed by *Natica* and *Thais*. All Murices are carnivorous; living free on the bottom they fill towards the non-burrowing

bivalves a role similar to that of *Natica* in respect of those that live buried in sand; they are capable of great damage and some of the smaller species, *Urosalpinx* sp. and others, together with the Purpurid *Drupa*, cause havoc on the pearl banks in the Gulf of Mannar when the pearl oysters are young and thin-shelled.

From some of the Murices the Phoenicians obtained their famous Tyrian purple dye; the animal was extracted whole from large shells, small ones were broken in a mortar. Vestiges of this industry still exist on the eastern coasts of the Mediterranean in heaps of broken *Murex* shells and in cauldron-like holes in the rocks.

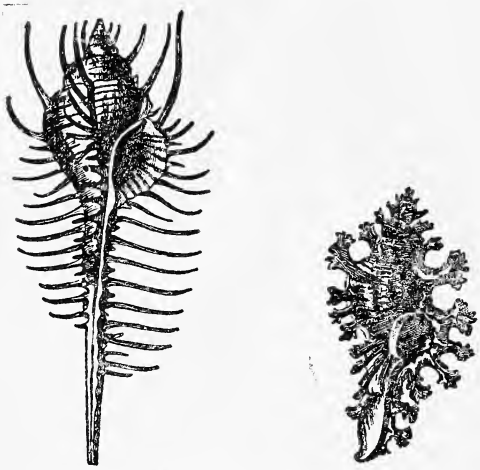

Fig. 24.—*Murex tenuispina* Lam. and *M. palma-rosae* Lam.

The handsome long-spined *Murex tenuispina* is often brought ashore by Madras fishermen, entangled by its spines in their trawl nets; the same species and the closely allied *M. ternispina* are common on the Bombay and Malabar coasts in moderately deep water. Both these have extremely long beaks beset with spines; the Woodcock-Shell, *Murex haustellum*, has an equally long beak but no spines; it bears a fantastic resemblance to the head of a woodcock, hence the popular name. It is common on muddy sand on both the East and West Coasts. Of short-beaked small forms, *M. palmiferus* is peculiarly handsome, the spines stout and branched. It occurs in the Gulf of Mannar.

Largest of all the Indian Murices is *M. ramosus*. This shell is found associated with the rather larger Horned Helmet-shells (*Cassis cornuta*) in deep water (10 fathoms) on the pearl-banks of the Gulf of Mannar. By the Tamil fishermen it is called *Ani sangu* or Elephant Chank. The shell is short and massive, the beak quite short and wide and the whole surface is beset with powerful spines, slightly curved. Closely related is *Murex anguliferus*, a small edition of the Elephant Chank. So alike are they that the smaller one has been supposed by some to be the young of the larger. The spines in the immature are less developed than in the adult and in this condition the angular shape is obvious. It is common on the Coromandel Coast and at the

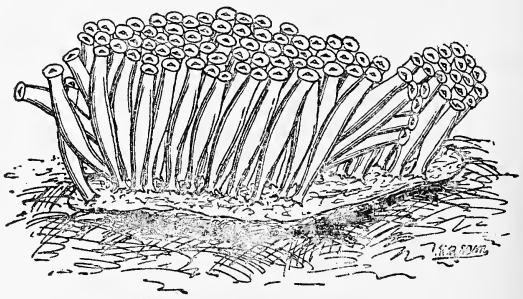

Fig. 25.—Egg capsule of a *Murex*.

Hindu temple at Tirukalikkunram this shell appears sometimes to take the place of a real chank in the miracle enacted periodically at this place which lies between Chingleput and Mahabalipuram. Here, at intervals of several years, a chank shell rises to the surface of the temple tank and among the shells thus miraculously produced and now kept in the temple treasury, I have seen two of *Murex anguliferus*.[1]

The Purples

The Purples (*Thaididae*) are littoral shells of small size found on all coasts.

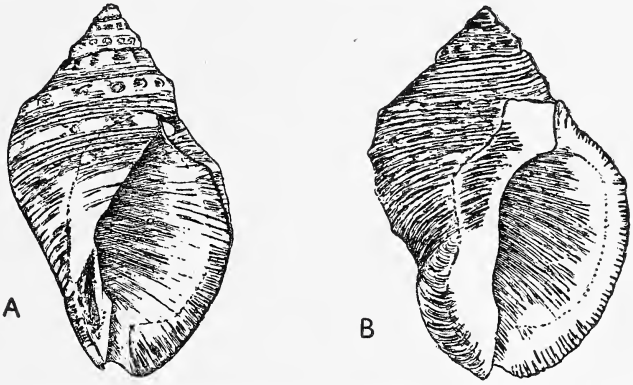

Fig. 26.—Two Common Purpurids, *Thais rudolphi* Lam. and *Thais bufo* Lam. ×1.

The two commonest Indian species, *Thais bufo* and *T. rudolphi*, are barely two inches in length, thick shelled and stoutly built, with a short spire and a fairly wide body-whorl and large aperture (Fig. 26, A and B). They live on rocks between tide-marks and, along with *Turbo*, on stone-strewn shoals; they are occasionally eaten by the shore people in Tamil districts in South India, while around Bombay *Thais carinifera* is collected in considerable quantities. *T. pica* is recorded from the Laccadives.

In habits the Purples closely resemble the Murices; they prey on other molluscs, obtaining access to the soft bodies of their victims by the same expedient of boring holes through their shells; they also secrete a fluid which turns to a dull crimson colour when exposed to light and which was used by the ancients for dyeing.

Rapana bulbosa is another common Indian species and a spiny little *Drupa* is a depredator on pearl-oyster brood.

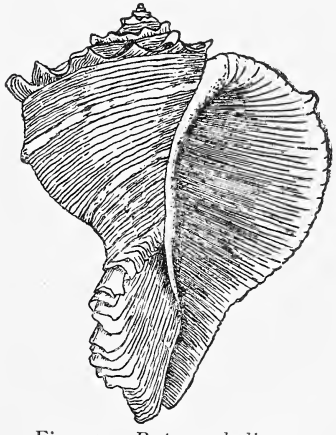

Fig. 27.—*Rapana bulbosa* Solander.

[1] Hornell, J., 'The Sacred Chank of India', *Madras Fisheries Bulletin*, vol. vii, p. 184. Madras, 1914.

Coral Shells

The closely allied family of Coral Shells (*Coralliophilidae*) comprises a curious group of molluscs of more or less sedentary habit that live on coral reefs, intimately associated with the living corals. *Coralliophila madreporarum* attaches itself to corals, but *Magilus* when adult lives wholly embedded in the living coral. When it settles down within a crevice of growing coral at the end of its free-swimming stage it assumes the appearance of a thin-shelled *Thais* (Fig. 28, B); as the coral continues its growth the shell gradually becomes surrounded and then imbedded in it until, to prevent being cut off and completely entombed, *Magilus* changes the growth of its shell from the spiral to the straight, lengthening the tube as the coral increases in thickness (Fig. 28, A). As this lengthening process goes on, the mollusc fills up the spiral portion of its tube with solid material. An operculum is retained.

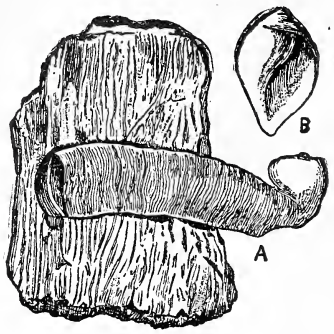

Fig. 28.—*Magilus*, showing the larval form of the shell (B), and the abnormal form assumed when adult (A).

(*To be continued*)

IDENTITY OF *MICROBRACON BREVICORNIS* WESM. AND *MICROBRACON HEBETOR* SAY.

BY

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Microbracon brevicornis Wesm., and *Microbracon hebetor* Say are two widely known species of world-wide distribution and are parasites chiefly of several Lepidoptera. A vast amount of literature has developed around these both in Europe and America on their biology, ecology, systematics including their synonymy. But the validity of these two being two distinct species is doubted and there are two groups of opinion, one group considering the two as distinct, the other considering them as one and the same species. The object of this paper is to review the position as it stands now and to present a few points on this aspect of study.

Microbracon brevicornis Wesm.—This is a well-known parasite of the European corn borer *Pyrausta nubilalis* Hbn., in Europe and is imported into North America to control the same there; in Egypt and elsewhere it is a parasite of the pink bollworm of cotton *Platyedra gossypiella* Saund.; in Russia intensive studies are being carried out on the ecology of this parasite for utilising it in the control of the cotton Noctuid *Heliothis armigera* Hbn; and in India it is a parasite of the coconut caterpillar *Nephantis serinopa* M. and of the moringa borer *Noorda moringae*. Richards and Thomson (1932) give a list of hosts as follows:—*Dioryctia abietella* F., *Pectinophora* (*Gelechia*) *gossypiella* Saund., *Pyrodercess simplex* Wlsm., *Ephestia cautella* Wlk., *Earias insulana* Boisd., *Batrachedra amydraula* Meyr., *Phycita infusella*, *Nephopteryx* sp., *Pyrausta nubilalis* Tbn., *Diparopsis castanea* Hmpsn., *Sesamia cretica* Led., *Vanessaio* L. They also mention that this parasite can be bred on *E. kuhniella.*, *Acrobasis obliqua Z.*, *Carpocapsa splendana* Tr., *Diatraea zeacolella* F., *Leucanja zeae* Dup., *Nothris senticella* Stdg., *Phthorimaea operculella* Z., *Sesamia nonagrinoides* Lef., *Tortrix viridana* L., and *Grapholitha rufillana* Stt.

Microbracon hebetor Say.—Richards and Thomson (1932) mention the host of this parasite as follows:—*Ephestia kuhniella, E. eleutella, E. cautella, Galleria mellonella* L., *Paralipsa* (*Aphomia*) *gularis* Zell., *Vitula adamondsii* Pack., *Sitotroga cerealella* Ol., the most common ones being *Plodia* and species of *Ephestia*. Ayyar (1934) has recorded it on *Corcyra cephalonica*. Glover and Chatterjee (1936) state (1) that they have recorded *M. hebetor* for the first time in North India, (2) that in India its usual host has not been discovered, (3) that it has been bred in the laboratory on *Eublemma amabilis* and *Holcocera pulverea*, and (4) that it being rare in North India had to be imported to Ranchi from Ceylon. They also give the hosts from Ceylon as follows:—*Ephestia kuhniella, E. cautella, Sitotroga cerealella* and *Corcyra cephalonica*. Ghulam Ullah (1939) contradicts the statement of Glover that this is rare in North India and gives the occurrence of this around Delhi attacking caterpillars of *Antigastra catalaunalis* in large numbers and he has also induced it to parasites *Platyedra gossypiella, Earias fabia, E. insulana, Laphygma* sp., and *Phthorimaea operculella* Z.

Thus the above host records for the two parasites show that *Microbracon brevicornis* is mostly a parasite of field pests and *M. hebtor* is a parasite of stored product pests, and this aspect has been well brought out.

With this as the back-ground, the next point to consider is their nomenclature. Richards and Thomson (1932) give the synonyms for *M. brevicornis* as follows: *vernalis, kitchneri, lefroyi;* and for *M. hebetor* as follows: *honestor, brevicornis* and *juglandis* and these authors give references in extenso which show the confusion regarding the identity of these two. There is no mention of these two parasites by Ramakrishna Ayyar (1928) and Richards and Thomson go to the

extent of saying that several of Ramakrishna Ayyar's species of *Microbracon* described by him may after all prove to be either of these. Cushman (1914) gives the synonymy with the relevant literature and shows the confusion prevailing. Lal (1941) puts this question of the relationship of *M. hebetor* and *M. brevicornis* to the fore and considers (1) that the two are identical (2) that some intermediate and aberrant forms exist in specimens reared from various hosts at New Delhi, and (3) that for the present these may be allowed to remain distinct, and (4) that later on these have to be considered as a biological or geographical race of the same species. But unfortunately Lal has not hinted at the manner of his studies morphological or otherwise.

Studies at Coimbatore.—Corcyra cephalonica is bred from Sorghum in large numbers in the Entomological Laboratory, Coimbatore, for mass breeding of *Trichogramma* parasites for liberation against the cane borers. But the larvae are found parasitised by *M. hebetor* in very large numbers and this material was used for the studies. It was found that the color of different individuals in the lot varied from pure honey yellow to dark with intermediate shades of varying depths on the thorax and abdomen and legs. The variations were wide. Therefore individual females constituting different grades of color shades were collected in July—August 1942 and separately reared. In the first few days all the progenies gave rise to individuals of different shades but later on only to dark ones. It is interesting to note that the purely honey-yellow ones also gave rise to black ones. In some instances breeding was carried on to 3 or 4 generations and even then dark adults continued to be obtained. Not only was there variation in color but there was variaton in size also especially of abdomen and thorax. Therefore these trials showed that color and size are of no value in determining the identity of these two species. In this connection references may be made to Whiting (1921) and Geniyes (1922) who have worked on these two species and studied the physiology of color variation; they indicate that color is governed by temperature.

Therefore another character, viz., the number of antennal joints was studied. With regard to this aspect Cushman's papers (1922) may be referred. Cushman has analysed the point well and states that (1) Wesmaels' (1839) description of his species *M. brevicornis* is based on an insect having 17 joints of antennae in the female and 20 to 26 joints in the male, (2) that Marshall (1885) has brought all British specimens having 14 jointed antennae in the female and 21-23 in the male under *brevicornis*. Cushman would appear to have examined a large number of Marshall's specimens for the female antennae and in no case was there more than 15 joints and the male antennae never more than 22. Curiously enough he has also found that the species as thus determined is apparently invariably parasitic on lepidopterous larvae such as *Ephestia, Plodia* and *Galleria* infesting stored products. He also mentions that examination of the parasites of the European corn borer (*Pyrausta nubilalis* Hbn.) imported into North America from Europe has shown that the large number of female specimens reared had only 17 jointed and the males 21-27 jointed antennae and that this species from Europe is the true *brevicornis* Wesm., and these though very closely allied to that of Marshall's in other respects differ in this particular respect.

The present authors have before them a large number of parasites reared from *corcyra cephalonica* at Coimbator and examination of these shows that the antennal joints in the females vary between 14-16 joints and in no case are they more than 16. Based on the observations of Cushman it may be definitely stated that these are not *brevicornis* but may be *M. hebetor* Say. Male and female specimens of *M. hebetor* recently obtained from Ranchi and examined by the authors showed that females had only 14 joints and males 21. Four female specimens were also obtained from the Imperial Entomologist. Of the two specimens reared from *Earias* and named as *hebetor* one had 15 joints and the other 16. The other two specimens reared from *Antigastra catalaunalis* and named *brevicornis* had 21 joints. Both determinations were by Lal. In the case of *Antigastra catalaunalis,* as the parasite has 21 joints, the species can never be *M. hebetor.*

Cushman's analysis makes it clear that the number of antennal joints has to be considered to distinguish the two species of *Microbracon.* In the present state of our knowledge it seems better to keep these two species separate

till further light is thrown on the subject. Cushman had the advantage of having Westmael's description of *brevicornis,* Marshall's specimens from Britain, specimens in the United States National Museum and the ones from Europe from the European corn borer.

Acknowledgements

The authors wish to thank the Imperial Entomologist, New Delhi and the Entomologist, Lac Research Institute, Namkum, for sending specimens for their studies.

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SWEET FLAG (*ACORUS CALAMUS*)—A POTENTIAL SOURCE OF VALUABLE INSECTICIDE

BY

T. V. SUBRAMANIAM, B.A., ENTOMOLOGIST

Acorus calamus, known as the *Sweet flag* in English, as *Vasambu* in Tamil, as *Vayambu* in Malayalam, and as *Vassa* in Telugu, is a semi-aquatic plant, perennial in nature, belonging to the Natural Order Aroideae. It is regarded as a native of Asia and introduced into other parts of the world because of its high medicinal value. Mention is made of this plant in ancient Ayurvedic literature. It is seen growing wild in all marshy parts of the Western Ghats round about the Nilgiris and in the plains in some places. It is cultivated on a small scale in the court-yards of houses near wells or other waterlogged places mainly for its medicinal use. Attempts were made to cultivate this on a field scale by the Madras Agricultural Department at the Palur Agricultural Research Station during 1933-34. The crop came up well, took one year to mature, and yielded about 3420 lbs. of dry rhizome per acre and fetched nearly Rs. 400 at the then rate of Rs. 3 per maund. The crop requires only low-lying waterlogged marshy places, unfit for any other more economic crop, for its cultivation, and does not demand much attention. Moreover, it is free from pests and diseases, and can easily be grown, if the natural sources of supply are found insufficient.

Leaves contain an essential oil used in England by perfumers in the manufacture of hair powder. From the rhizome a pale or yellow dark oil with a strong odour and an aromatic bitter burning flavour (due to the presence of a glucocide known as *Acorin*) is obtained. The rhizome is very largely used in medicine in all parts of the world for various diseases. In our province, and probably in other parts of India too, there is a common practice, of administering the dry rhizome rubbed in honey to babies in arms as a tonic. It is made into an infusion in water and used to wash new-born calves as a protection against vermin.

Though mention is made casually in literature about the insecticidal properties of the plant no definite attempts seem to have been made to assay the real value in this direction till very recently. Probably the first earnest attempt in this line was made at the entomological laboratory of the Agricultural College and Research Institute, Coimbatore, about the year 1938. This was continued for some years with the result that the rhizome of the plant has been proved to possess definite insecticidal properties against a variety of insects affecting field crops, stored grains, clothing, and other household articles.

The most important use for the insecticide is in the preservation of grains in the granary free from the damage by insects. This aspect received considerable attention from the year 1938 onwards. After more than a dozen trials conducted during the period 1938-1947 it can definitely be claimed that it is possible to preserve grains like cholam, paddy, rice and pulses free from any appreciable damage from insects for sufficiently long periods, say for eight months or even a year. The grains are thoroughly mixed with finely powdered rhizome at the rate of 2 lbs. for every 100 lbs. of the grains (at the most) before storage. Lower doses, even when diluted with an inert powder like china clay, have been found to be efficient. Taking the cost of the powder to be about four annas a pound, it may be possible to protect the grains at an average cost of about eight to twelve annas a bag for sufficiently long periods. Considering the large quantity of food stuffs that are reported to get deteriorated during storage in these days of food shortage this is decidedly better than the remedial measures like cleaning and reconditioning or fumigation of grains after the damage is over—not to mention the cost and danger attending these operations. This treatment is certainly one that has to receive attention at the hands of the food department. The appendix gives details of two of a series of trials conducted in the preservation of grains with *Acorus.*

'Trials made with the rhizome and leaves of Sweet flag as dry powder and as water infusion have proved their efficacy against crop pests like plant lice and grubs of beetles. But it has to be remembered that the treatments are effective only when a small quantity of soap is added to the infusion. The strength of the infusion is only one ounce per gallon of water, prepared by steeping the material in water for a day or boiling it in water for about 45 minutes and cooling.

The following laboratory trials with the powder give sufficient indication of its effectiveness in the control of house flies :—

(1) A large number of flies were enclosed in a glass jar covered with muslin and dusted over with *Acorus* powder at 8-30 a.m. in the morning and all were found dead by 11 a.m. The flies in the untreated lot were all alive.

(2) Adult flies were enclosed in four glass jars with muslin covers; two of these had the flies dusted over with *Acorus* powder while the flies in the other two jars were left untreated; the flies in all the jars were fed with honey. At the end of 24 hours the mortality in both the treated jars was 100 per cent; but it was only $3\frac{1}{2}$ per cent and 2 per cent in the two controls.

(3) Four glass jars were each filled with one pound of fresh cowdung. In two jars the material was mixed with quarter of a pound of *Acorus* powder while the dung in the other two was left untreated. All the jars were covered with muslin after the introduction of 100 flies in each. On the third day when all the flies were dead they were removed and the dung kept under observation. On the sixth day maggots were seen in the control lots and flies began to emerge by the tenth day while in the treated lots maggots were not seen at all and no flies emerged. On the whole 227 and 497 flies emerged from the two control lots. This indicates that mixing of *Acorus* powder with cowdung will prevent house flies from breeding in it.

(4) Two pounds of fresh cowdung was put in two jars and a thin layer of *Acorus* powder dusted on the top. (1/16 oz. of the powder was used for covering an area of 28 sq. inches). Two similar lots were left untreated. 50 adult flies were left in each jar and the jars closed with muslin; the flies were fed with honey. Flies in the treated jars died the same evening while those in the untreated jars lived for two or three days. Maggots began to appear in the control jars from the seventh day and flies began to emerge later on. While the controls yielded 266 and 56 adults respectively in the two jars, there was no breeding at all in the treated jars.

In a casual trial against the grubs of the coconut beetle (*Oryctes rhinoceros*) the result was promising. In two jars cowdung manure with 12 grubs of the beetle were put in and enclosed with muslin. The dung in one lot was mixed with acorus powder at the rate of one ounce per pound of manure while the dung in the other jar was left untreated. The grubs in the treated manure began to feel uneasy from the beginning and died in the course of 18 days while the grubs in the control lot were hale and healthy.

Acorus powder also promises to be useful against clothes moths. In two small trials it was found that the moths died in the course of a few hours when the flannel pieces on which they were left were dusted with the powder, while the moths on the untreated material were thriving for a number of days and laid eggs and caterpillars hatched and flourished well.

The powder appears to be toxic to bed bugs too. When dusted over the bugs it killed the insects in the course of a few hours; though it had no effect on the eggs, the nymphs died as soon as they were hatched and came in contact with the powder.

The effect of the powder against lice on fowl was tested on two occasions with convincing results. In one case two badly infested birds were enclosed separately in two cages with white paper spread on the floor. One bird was well dusted with acorus powder while the other was left untreated as control. Half an ounce of the powder was required for a fairly big sized bird. The next morning, i.e., after 12 hours the two birds were well shaken to dislodge the lice on them on the paper below and it was found that 505 dead lice were recovered from the treated bird, but not a single one was obtained from the untreated bird. After renewing the paper flooring in the two cages the birds were kept again for another day and the next morning 10 more dead lice were recovered from the treated bird and none from the control. Repetition of the process on the third day gave 6 more dead lice

from the treated bird with none from the control, making up a total of 521 dead lice from the treated bird with none from the control. On the fourth day the control bird was similarly dusted and left in its cage and the next morning 343 dead lice were recovered from it. Thus the effect of the treatment is very striking. A few small chicken were dusted with the powder to see if the treatment affected them adversely and it was found to be safe.

From the various trials enumerated above it is clear that *Acorus* promises to be an almost ideal insecticide. It is cheap, simple and effective; it is readily available and can be easily cultivated; it is toxic to a wide range of insects both of the biting and sucking type, but is absolutely harmless to higher animals and man. It does not scorch the plants when applied to crops in the field and does not adversely affect the germination or the eating quality of grains when mixed with them. From the promising nature of the insecticide it deserves the attention of entomologists for further detailed investigation and the attention of the Government for encouraging the use of it, especially when it gives such great promise in the preservation of food grains which is a vital point in these days of food shortage and when every grain saved is an asset to the country.

APPENDIX

Experiment No. 1.

In this experiment which was started in October 1938 the following substances were used to test their efficacy in protecting grain from insects: leaves of Neem, Pungam and Tulsi, lime powder to which creosote was added at the rate of ¼ oz. per pound, paracide, powdered rhizomes of *Acorus*, powdered flowers of *Pyrethrum*, and powdered roots of *Derris*. The grains were paddy and cholam. 192-200 lbs. of cholam and 150-180 lbs. of paddy were stored in each bag after mixing the grains with *Acorus* powder at the rate of 2 lbs. for every 100 lbs. of the grains. Every month a random sample of one pound of the grain was taken from each bag and the incidence of calandra beetles in it recorded and the grain with the live beetles put back in the respective bags. After a year, in December 1939 the whole quantity of grains in all the bags were examined and the insects and the final loss of grains recorded. A perusal of the figures given below will show that *Acorus* prevents insect damage to a great extent. Curiously enough the number of insects at the final count is larger in acorus lot than in the control; but most of them were dead.

—	—	January	February	March	April	May	June	July	August	September	October	November	December	Final No. of beetles	Final loss
Paddy Cholam	*Acorus* ...	19	2	53	12	15	...	4	23	45	154	156	343	48,792	10·6 %
	Control ...	59	39	59	31	13	9	8	49	117	205	382	413	63,650	21·6%
	Acorus ...	...	...	1	...	1	2	3	2	...	...	2	3	107	4%
	Control ...	...	...	4	1	...	...	4	5	2	2	1	...	137	6%

Experiment No. 2.

Experiment No. 1 was repeated again in June 1940 using 170 lbs. of cholam per bag and 100 lbs. of paddy per bag. Final counts were taken in September 1941.

The figures here also show a greater number of beetles in the final examination in the *Acorus* treated lot as before consisting of a large proportion of dead ones, in cholam; the insect population during the various months is lower. The insect population in paddy is as in the previous experiment lower

in the treated lot. The final loss in both cholam and paddy is very much lower in the *Acorus* lots than in the controls.

—	—	September 1940	October	November	December	January 1941	February	March	April	May	June	July	August	Final	Final loss
Paddy Cholam	*Acorus.*	5	124	189	185	176	249	120	110	30	19	14	28	156,583	3·2%
	Control.	101	307	227	431	353	411	240	723	30	17	11	35	57,682	27·7%
	Acorus.	...	6	38	51	8	9	2	...	...	...	2	4	88	2%
	Control.	4	22	49	74	51	15	8	7	1	5	2	3	219	4%

REVIEWS

1. JOURNAL OF THE ZOOLOGICAL SOCIETY OF INDIA, Vol. I, No. 1—January 1949. Edited by K. N. Bahl, D. Phil., D. Sc. (Oxon.), F.N.I.—Price Rs. 10 (inland); Rs. 11 (foreign).

The Zoological Society of India has just issued the first number of their journal from Calcutta. It comprises of 70 pages with 22 pen and ink illustrations and a plate of photographic reproductions. ' The journal has been priced at Rs. 20 per volume of 2 half-yearly issues ' and taking the present one as a standard, the price is justified. The editor is Dr. Bahl, Professor of Zoology, Lucknow, who is a well-known zoologist, even beyond the regions of this country. Contributors to scientific journals in India have suffered from want of respect to merit. As in politics, the editors have their parties and mutual admirers without whose blessings no article can be accepted for publication. Prof. Bahl is well respected for being above all such politics and it is hoped that the journal will offer encouragement to many a budding zoologist. In the past the dissenters could find a chance of publishing their articles only in foreign journals but war conditions have greatly minimised such opportunities. A journal under Prof. Bahl's editorship can be depended upon to extend hospitality to all meritorious workers irrespective of their scientific caste or zoological creed. The printers are the well-known ' Catholic Press ' of Ranchi which already prints the journal ' Scientific and Industrial Research ', New Delhi. The printing leaves nothing to be desired.

The journal opens with a contribution by the Director, Zoological Survey of India, which is as it should be. Dr. Hora makes a masterly contribution on his special subject Fish fauna, with observations on zoogeography and paleography of the Rihand river, in Mirzapore, U. P. Major Roonwal's address before the Zoological Society of India, at Patna, January 1948, appears as a great contrast to the previous article, as the treatment is thoroughly philosophical, with a reference to ' Ethics of Zoology ' by Annandale and a quotation in German from Schöpenhauer. However, we would like to point out, incidentally, how well he surveys the work of Indian zoologists. He says ' Last year we published 300 zoological papers in the country. . . . 150 were Indian Science Congress abstracts which did not go beyond the " abstract " stage . . . and alas ! only 20 were large and critical monographic works on morphology and systematics '. Every editor is a benefactor in a way and unless merit is recognised and the writer encouraged, no solid work can be carried out. The want of a proper organ for zoological publications has greatly discouraged such work as Major Roonwal rightly misses. Three separate articles by Loos of the Tea Research Institute of Ceylon deal with Nematodes and are well illustrated. Bioluminescence is so attractive a phenomenon that we wonder why so little has been written on the subject from India. K. S. Misra's note on *Scopelus* (*Lampanyctus*) *pyrosobolus*, is also of the category of ' write short notes on ' and offers room for a monographic study to be taken later on.

As a contrast to morphological papers, S. V. Ganapati of Madras has an interesting paper on the role of blood-worm *Chironomus plumosus*, as observed in sand filters of the Madras Water Works and another on abnormal surface congregations of fishes. There are two papers on insects: on a Dermestid Beetle by K. S. Pradhan and on Potato Moth, by A. K. Mukerji. Birds, which form the most favourite subject of study amongst zoologists elsewhere, are not given the attention they deserve in India. They are conspicuously absent in the issue of the journal of the Zoological Society of India, under review. G. Mathai has a note on cleaning insects preserved in a museum, damaged by flood which left silt upon the specimens. Two publications have been reviewed, one signed by Roonwal. The obituary notice of Dr. Bhalerao appears rather short in our view, considering his achievements and his popularity.

We extend the journal a warm welcome and would be happy to co-operate in furthering a cause which is equally dear to us.

S. M.

2. WILDLIFE FOR AMERICA : THE STORY OF WILDLIFE CONSERVATION. By Eward H. Graham and William R. Van Dersal. Pp. 109. Illustrated. Size $9\frac{1}{4}'' \times 6\frac{3}{4}''$. New York—Oxford University Press, 1949. Price $2-50.

The appearance of this superbly illustrated and informative little book could not have been more opportune. We in India have just woken up to a realization of the same serious problems as confronted America after the early settlers had established themselves : namely the evil consequences of upsetting the balance of nature by thoughtless destruction of natural resources. Trappers explored remote parts of the country for furs. Settlers followed in their wake and cleared the forests for cultivation. The originally abundant wildlife was killed off in the greed for gold which the fur and feather trade provided, or as food for the settlers, through sheer blood-lust or as wholesale reprisal for alleged destruction to livestock and cultivated crops.

Some of the animals were destroyed directly by human agency, others perished through drastically altered conditions many which could have been avoided by the exercise of a little forethought.

Large areas were denuded of forest, exposing the ground to the full force of the rain by the removal of the intervening canopy. The matting of rotting leaves on the forest floor which soaks up the rain water like a sponge and prevents it from running off in swift flowing channels was destroyed causing erosion of the soil. Overgrazing by many more cattle than the land was capable of supporting destroyed the soil binding grass and caused erosion of the pasture land. Marshy land was drained and dry land was irrigated for raising crops. The landscape changed completely, and with it the native wildlife. Some species changed their habits to suit the new conditions, others went under altogether or in varying degrees.

Passenger Pigeons, the last example of which died in Cincinnati Zoo in 1914, were so abundant till less than a hundred years ago that it seemed no amount of killing could affect their numbers. They were slaughtered by cartloads, in hundreds of thousands, as food for the settlers. Buffalo once estimated at 60 million head, were so mercilessly persecuted for their hides that they would all be gone by now but for the protection afforded by comparatively recent National Parks where a very few still remain. Thirty other kinds or American wildlife have now become so scarce as to be listed among vanishing species.

With the growing insufficiency of food for a teeming population that continues to increase at the alarming rate of about 5 millions a year, it is not surprising that in India a demand is sometimes made even by people of normal but ill-informed intelligence that all areas capable of supporting any food crops be thrown open and cleared of the forest growth that now gives refuge to wildlife, and that all wildlife wherever it comes in the least conflict with human interests be destroyed. Little do such people realize the essential role that wildlife plays in the scheme of nature. For inconsistent as it may seem experience in the U.S.—85% of whose total land is used for farming or ranching—has shown that with proper scientific management, farming and ranching are actually made better if wildlife is present, and that agriculture, forestry and wildlife go best hand in hand.

Under the rapidly changing conditions in India and with public opinion so inadequately informed on the subject there is little realization of the fact that wildlife is a priceless national asset which is steadily vanishing through wanton destruction. Once lost, it can never be replaced ; therefore it is essential that every medium of propaganda at our disposal should be harnessed in order to spread accurate knowledge and create an appreciation of the wonderful wildlife that we happily still possess and which it is our duty to preserve and hand down to posterity.

A moral responsibility for moulding the correct attitude towards nature rests upon the teachers of the young. For the youth of to-day will be the citizen of to-morrow ; and among the many attributes we expect in the good citizen is an understanding attitude towards wildlife, an attitude which will concede to it the conditions necessary for unpersecuted existence.

' Wildlife for America ' is an admirable attempt to provide the basic facts concerning the important position wildlife occupies in nature's economy, and by telling us in simple language and by eloquent picture what has been, and is being done in the U.S. to guard and improve this heritage provides pointed suggestions for what may be achieved in our country and how.

S. A.

3. ADVENTURES WITH A NATURALIST. By Roy Bedichek. London—Victor Gollancz Ltd. 1948. Price 12*s.* 6*d.*

This book covers a series of more or less disconnected observations on varied aspects of natural history, mostly with reference to Texas. It therefore does not meet the promise held out by the title but is interesting from a different angle.

The essays wander over many subjects and observations, ranging from the courtship of a flycatcher and the extermination of the golden eagle, to the influence of fencing upon wildlife and the truly American statement that it is estimated that Texas has paid thirty million tons of humus laden soil for every bale of cotton she has ever marketed.

Though some of the items are of local interest, many general observations, particularly with the reference to the preservation and protection of the fauna and flora of the country are of topical value to us. America has lost some of its original wildlife, but subsequent action has placed an appreciable amount on a safe footing. In India, we are still losing and only time will tell if the efforts of the Bombay Natural History Society, with its very limited resources, will be effective.

When the railroads were being built in America, the various companies acquired rights of way extending right across the country in every direction; many of these have been unused and have left long stretches of indigenous vegetation, together with a part of its fauna in cross section form. The late President Roosevelt also suggested that if super-highways were to be built across the country from coast to coast, a strip of land a mile wide on each side should be held under government control providing innumerable opportunities for parks, arboreta, wildlife preserves, natural scenery, sanctuaries and other amenities for the nature-conscious. We wish our government would also think on similar lines and not calculate how many chawls can be built on every square foot of open land along the roadside.

For the preservation of wildlife, the first essential is to know the habits of the animals it is intended to preserve. When motor cars were first introduced there was great consternation among the horses, and many carts were wrecked and necks broken. Horses have become used to them but many animals both wild and domestic, which depend upon speed for their safety will run down the track in front of an approaching train or car, until they are killed, because they are unable to learn that the oncoming vehicle cannot leave the track which is built for it. The jack rabbit is an example. The armadillo has another difficulty. At the strange noise of an approaching car, it stands up on its hind legs and sways his body from side to side to try and verify his possible enemy by smell. This results in his being hit on the head by the bumper and killed.

Fortunately for everybody including ourselves in India, the fashion in egret plumes has passed and this drain on wildlife has stopped. Much of folklore and naturelore current is critically examined by the author. In India where we have a glut of mythical beliefs about the use and value of animals and plants, a similar detailed and authoritative commentary would be invaluable. A large number of pseudo-medical and similar beliefs prejudicial to many species would be exploded, e.g., aphrodisiacal value of the rhino horn, which has brought the animal to the verge of extinction.

Reference is made to a film showing that the European cuckoo does carry its egg to the fosterer's nest in its beak. We thought that this theory had long been buried, and also repudiated by cine-photographs. Some stories do die hard.

Though it belies its name, the book is interesting and of a kind which might be profitably attempted in India to arouse interest in the innumerable facets of our wildlife.

H. A.

4. THE PARASITIC CUCKOOS OF AFRICA. By Herbert Friedmann. 10 plates. Pp. viii+204. Size 9″×6″. Washington Academy of Sciences, Washington, D.C.—1948.

The Washington Academy of Sciences is to be congratulated on its plan to publish a series of monographs, of which the present is the opening number, and we hope the model.

Dr. Herbert Friedmann, Curator of Birds, U. S. National Museum, won international fame as an ornithologist by his monumental and almost classic

work on the American Cowbirds, published in 1929. The subtitle of that work 'A Study in the Biology of Social Parasitism' is an indication of the trend of his particular interest which he was later enabled to pursue in Africa by extensive field studies. In The Parasitic Cuckoos of Africa he has marshalled,—and in some cases analysed and discussed—all the data either obtained by himself personally or so far recorded by other competent observers on the life histories of African cuckoos, particularly bearing on the habit known as nest-parasitism or brood-parasitism.

Of the many species and topics discussed which carry a direct appeal to bird students in this country, perhaps the section on the genus *Clamator* (pp. 1–52) is of the greatest interest. Particularly illuminating is that portion of it which deals with the Pied Crested Cuckoo (*Clamator jacobinus*), a bird which comes into prominence in many parts of India during the monsoon months through its plaintive metallic calls. The typical race of this cuckoo (*C. j. jacobinus*) is a resident of Ceylon and a portion of Madras Province. The rest of India is inhabited by a larger race *C. j. pica* which is believed to spend the winter in Africa. Indeed the rather extraordinary suggestion has been put forward that contrary to all known precedents this bird breeds both in its residential and in its migratory areas laying a blue egg in India and a white egg in Africa!

We gather from the author that apparently the only authentic evidence of a white egg being laid by this cuckoo in Africa rests on the finding of one such egg in the oviduct of a female shot in Kenya Colony and identified on reliable authority as belonging to the race *pica*.

In this connection it is pointed out that in Africa there are 3 types of *Clamator jacobinus* which must all be considered as belonging to the same species: No. 2 is a proper race by itself, while 1 and 3 are merely colour phases of the same race and not two separate races of *C. jacobinus*.

Type 1: Completely black, with white wing patches ... *serratus*
Type 2: Like above but with white underparts ... *pica*
Type 3: Like 2, but with dusky underparts and greyish throat and breast ... ... *hypopinarus*

The race *pica* breeds in the Asiatic portion of its range (i.e., in Arabia, Iran Baluchistan, Afghanistan and northwest India) laying the well-known greenish blue egg. It also breeds in portions of its African range (in Ethiopia, Sudan, and parts of the Belgian Congo and Kenya Colony) laying the same typical greenish blue egg. Such records as exist of the occurrence of *pica* farther south in Africa (i.e., in the residential range of *hypopinarus*) relate to migrant and wintering birds only.

Dr. Friedmann feels that the only conceivable explanation for the white egg taken from the oviduct of an alleged *pica* in Kenya Colony, is that although birds from equatorial Africa (the boundary zone between the 2 races) may be morphologically like *pica*, yet they may in fact 'physiologically' be *hypopinarus* which is characterised by laying pure white eggs. This is certainly one explanation, but it shows how much room there still is for confirmatory evidence. Also from the identical calls and habits of *serratus* and *hypopinarus*, as well as from their completety over-lapping breeding ranges, their identical white eggs, hosts, ecological distribution and food habits, supported further by the fact that the two types have been observed mating with each other, he is convinced that *serratus* and *hypopinarus* are merely colour phases of a single form.

Considering the large numbers of Pied Crested Cuckoos which arrive to breed in north and central India during the south-west monsoon season every year, it is deplorable that so little is known of their movements. Whether this influx is merely from western Asiatic countries, or in fact from Africa as has been suggested, can only be ascertained by the ringing method. In spite of obvious difficulties in the way of trapping adequate numbers of adult Pied Crested Cuckoos for the purpose, or of finding a reasonable quantity of their nestlings, it is nevertheless a line of field work which holds important possibilities and one that can be earnestly commended to those with the necessary opportunities.

By bringing together in one volume the wealth of relevant African cuckoo literature that lay scattered pell-mell among the pages of numerous journals, Dr. Friedmann has rendered a service to ornithologists the true extent of which

can be more fully appreciated only by those who like himself are specially interested in this branch of ornithology and have experienced the difficulties of access to references.

'The Parasitic Cuckoos of Africa' forms an important addition to the literature on this interesting group of birds; it is a book that no serious ornithologist can afford to do without.

S. A.

5. ANIMAL ENCYCLOPAEDIA (MAMMALS). By Leo Wender. Pp. 266. Line illustrations. London : George Allen and Unwin Ltd. 1948. Price: 12*s.* 6*d.* nett.

In reviewing this book one can do little better than quote from the dust cover :—

'This book is unique. It is nothing less than a complete dictionary of mammals containing the essential facts about the habits and characteristics of every known mammal in all its varieties. Never before has so much information on this subject been presented concisely in one volume. In this remarkable work not only can the layman discover easily all he wants to know about animals he may have observed in the Zoo, but the student of Zoology will find it an essential reference book.'

It is really a remarkable work in which is included an enormous amount of miscellaneous information about well-known animals and also those which are mere names to most of us. Many of them like Anoa, Arui, Coati-mundi, Cuscus, Indri, Nyala, Vicugna, Wallaroo and Wanderoo, are unfamiliar and startling and few would know where to look for information pertaining to them. This is a very comprehensive dictionary which tells you the family to which the animal belongs and also the places where it is found. We would again quote from the Foreword by Martin A. C. Hinton of the British Museum :—

'We hand over The Animal Encyclopaedia to the reader and friend of Nature with the firm conviction that it will become a useful handbook to everybody for everyday use.'

H. A.

The following books have been added to the Society's Library since February 1949 :—

1. WONDERS OF THE GREAT BARRIER REEF. By T. C. Roughley (Angus and Robertson. 1948).
2. BIRD DISPLAY—AN INTRODUCTION TO THE STUDY OF BIRD PSYCHOLOGY. By Edward A. Armstrong (Cambridge University Press, 1942).
3. A GUIDE TO BIRD WATCHING. By Joseph J. Hickey (Oxford University Press, 1943).
4. ANIMALS—THE NATURE LIBRARY. By Ernest Thompson Seton (Doubleday, Doran & Company Inc., 1926).
5. BIRDS—THE NATURE LIBRARY. By Neltje Blanchan (Doubleday, Doran & Company Inc., 1926).
6. BUTTERFLIES—THE NATURE LIBRARY. By Clarence M. Weed (Doubleday, Doran & Company Inc., 1926).
7. GARDEN FLOWERS—THE NATURE LIBRARY. By Robert M. McCurdy (Doubleday, Doran & Company Inc., 1928).
8. WILD FLOWERS—THE NATURE LIBRARY. By Neltje Blanchan & S. A. Don Dickin. (Doubleday, Doran & Company Inc., 1926).
9. TREES—THE NATURE LIBRARY. By Julia Ellen Rogers (Doubleday, Doran & Company Inc., 1926).
10. THE AUK—A QUARTERLY JOURNAL OF ORNITHOLOGY. (Published by the American Ornithologists' Union—commencing from Vol. 61).
11. WILDLIFE FOR AMERICA—THE STORY OF WILDLIFE CONSERVATION. By Edward H. Graham & William R. Van Dersal (Oxford University Press, 1949).
12. GIANT FISHES, WHALES & DOLPHINS. By J. R. Norman & F. C. Fraser (Putnam, London, 1948).
13. BIG GAME HUNTING IN INDIA & THE GAME ANIMALS OF INDIA (Government of India, 1948).

OBITUARY

C. G. WEBB-PEPLOE

Charles Godfrey Webb-Peploe died on February 19th last at the age of 47. He was educated at Weymouth College and St. Catherine's College, Cambridge, taking an Honours degree in History and English. After a period of service as a young people's missionary in China he came to India in 1926 and became a member of the Dohnavur Fellowship, Dohnavur, Tinnevelly District. At first he was responsible for the work among the boys, and subsequently for the general direction of the Fellowship in co-operation with Miss Amy Carmichael, its founder.

Both children and grown-ups benefited greatly from his love of natural history, a hobby to which he brought the same careful and painstaking thoroughness that characterised his whole life. He saw the Creator in all His creation, and delighted to show Him to others.

J. E. R.

[Mr. Webb-Peploe contributed the following interesting notes and articles to the *Journal* :—

Articles: 1. Field Notes on the Mammals of South Tinnevelly, S. India (Vol. 46, No. 4, p. 629).
2. A Census of Nests in a Private Bird-Sanctuary. (Vol. 47, No. 4, p. 676).

Notes: 1. Breeding Habits of the Common Krait. (Vol. 45, No. 3, p. 437).
2. Notes on a few birds from the south of the Tinnevelly District. (Vol. 45, No. 3, p. 425).
3. Dawn Chorus in a South Indian Forest. (Vol. 46, No. 4, p. 732) —EDS.]

F. E. BHARUCHA

In the death of Mr. F. E. Bharucha on 1st July 1948 the Bombay Natural History Society has lost a valued friend and the science of natural history as such mourns the loss of a keen student. He was born in Nagpur on the 29th April 1891.

After doing his M. A. in history from Bombay university he studied law and obtained the LL. B. degree in 1917. Although natural sciences did not figure in his academic record, from an early age he had taken a liking to the study of Botany and perseveringly built up a collection of orchids which at present is valued high for its variety and rarities. Both at Poona and Bombay he took keen interest in his gardens, spent a lot of time and money on them and devoted himself keenly to many experiments. He did not practise at the bar but pursued a commercial career with his father-in-law, the late Sir Phiroze C. Sethna. He was a director of many commercial concerns and was a busy man, but these distractions did not prevent him from cultivating his creative tastes. Besides possessing a very distinguished library of books he made a remarkable collection of rare old prints of Bombay which is valued very highly. He was also a connoisseur in music. He himself played first violin for a long

period in the amateur orchestra of Mr. Behr and contributed some articles in the *Illustrated Weekly of India* on the subject of appreciation of music. He was a member of the Society from 1926 to 1948 and also a member of the Executive Committee from 1933 until his death.

D. N. M.

JAMES HORNELL

(1865—1949)

In the death of James Hornell, F.L.S., F.R.A.I. which occurred in England on the 24th of February this year, the world lost a great international figure who had made a name not only as a practical fishery expert but also as an eminent scientist in the fields of marine biology and anthropology. We in India have good cause to remember him with gratitude, for his excellent pioneering work in the field of fishery development and his innumerable publications—veritable mines of information and invaluable guides, to fishery workers for all time. Also for his sustained interest, till the very end, in his life-work—attempts to focus attention on fisheries as a valuable national asset. This is shown by his sending to Dr. Hora as lately as 1946 well-thought-out suggestions, couched in his characteristic clear and inimitable style, for the development of marine fisheries in India and the industries dependent thereon.

Hornell was born 84 years ago in Scotland ; he was intended for the medical profession but circumstances forced him into a commercial career at Liverpool. His natural proclivities could not however be suppressed and erelong he turned in earnest to science, thanks largely to the friendship and encouragement of Professors Marshall, Hurst and Herdman. Under the direction of the last his early research work was done resulting in his first publication—a systematic report on a collection of marine worms for ' The Fauna of Liverpool Bay '. Thus began his lifelong association with marine zoology and he spent several fruitful years in the Channel islands in tackling fishery problems as well. As a partner in the famous firm of suppliers of biological material ' Sinel and Hornell ' which on the death of his father-in-law Sinel, become ' Hornell & Co., Jersey ' his name was familiar to students of natural science all over Europe. Years later in Tuticorin he started similar work and thus enabled students of zoology in Indian Universities to handle and study for the first time the various faunal constituents of our seas.

Hornell who came first to Ceylon in 1901 with Professor Herdman of Liverpool, to investigate the famous pearl fisheries of the island rendered meritorious service to the Ceylon Government as the Marine Biologist and Inspector of Pearl Banks. In 1903 he rediscovered a bed of pearl oysters previously lost, and in 1905 conducted a fishery with such phenomenal success as to net in over Rs. 25 lakhs from the sale of oysters. In 1906 the Ceylon Company of Pearl Fishers Ltd. which took over the control of the pearl banks for 20 years engaged Hornell as their biologists and surveyor. Though in 1906 and 1907 Hornell conducted 2 pearl fisheries which brought in a substantial income to the Company, by 1908 all hopes of early

resumption of pearl fisheries vanished and so Hornell resigned to join at Tuticorin the Madras Fisheries department. He became the Director in 1918, and retired from the post in 1923. He had previously, in 1904 when in Ceylon service, inspected the Madura and Tinnevelly pearl banks and submitted a valuable report to the Madras Government. In 1905 at the request of the Baroda Durbar, the Ceylon Government deputed Hornell to investigate the marine resources of Okhamandal, particularly its pearl fishery possibilities. He visited Baroda again in 1917 and in 1929. In 1909 Hornell, inspected at the request of the Bombay Government the Edible oyster beds near Karachi and reported on 'the present depletion of oyster beds in Sind'. Two items of work done by Hornell when in Ceylon are of interest to us in India; one was his successful pearl-inducing experiments and the other the cruise of the Company's trawler 'Violet' which located extensive trawling grounds opposite Cape Comorin and off the Tanjore coast. The former led to the Madras scheme of pearl farming in Krusadai island biological station and the other to the deepsea fishing experiments intensively undertaken by the Madras Government recently. It was because of his presence in the Madras Fisheries that the department took over the management of the pearl and chank fisheries in 1909 and that of the Madras Marine Aquarium in 1919.

Hornell always kept himself abreast of modern developments by utilising his leave to study fishery practice in other lands. In 1909 he visited France (Arcachon), Italy (Comacchio) and Scotland. In 1920 he visited Denmark and Norway and as a result recommended the introduction into India of the Danish cutter and the Danish seine. Hornell's advice was sought on fishery matters by various governments in the East from Mauritius, Seychelles, and Sierra Leone to Fiji. The Colonial Office engaged him to reorganise fisheries in Palestine, Malta, West Africa, Indonesia and the Pacific. He took an active part in a number of fisheries conferences and meetings including the Colonial Fisheries Conference held in England in 1946.

Hornell's contributions on marine biology have been very many and he dealt with all animals of economic importance. His studies on fishing boats, tackle and methods led him into the interesting borderland between history and anthropology. His studies on the relationship and origins of Eastern seacraft with his conclusions which shed great light on the relationship of the coast populations of the East were widely appreciated and were continued when he went on the South Sea Expedition financed by the Scientific Expedition Research Association and a grant from the Percy Sladen Trust Memorial Fund. With all this material collected he gave the world in 1946 the classic and monumental book 'Water transport: Origins and Early Evolution.' Photography was a hobby of his and he illustrated his articles, etc. with his own photographs which added to their value immensely.

His prolific writings stand as a monument to his industry and zeal. A list of his classified publications is given below:—

PEARL FISHERIES:

1. 5 volumes of reports to the Government of Ceylon, on the Pearl Fisheries of Ceylon, published by the Royal Society, London.

2. Explanation of the irregularly cyclic character of the Pearl fisheries in the Gulf of Mannar, *Madras Fisheries Bulletin* No. viii, 1916.
3. Report on the Pearl fishery held at Tondi, 1914. *M.F.B.* No. viii, 1916.
4. Professor Huxley and the Ceylon Pearl fishery with a note on the cultural production of fine spherical pearls. *M.F.B.* No. viii, 1916.
5. Pearl formation in the Indian Pearl Oyster. *Journal and Proceedings of the Asiatic Society of Bengal*, New Series, Vol. XVIII, 2, 1922.
6. Report on the Indian Pearl fisheries of the Gulf of Mannar, Madras 1905 (*M.F.B.* No. xvi, 1922).
7. Report on the inspection of pearl banks in Gulf of Mannar and Palk Bay in March and April, 1923, *M.F.B.* No. xvii, 6. 1923.

Oyster Culture:

1. Report on the suitability of Pulicat Lake for oyster culture. *M.F.B.* No. iv, 1908.
2. Note on an attempt to ascertain the principal determining factor in Oyster spawning in Madras Backwaters. *M.F.B.* No. iv, 1908.
3. The practice of Oyster culture at Arcachon and its lessons for India. *M.F.B.* No. v, 1910.
4. The present depletion of the Oyster beds of Sind; its causes and the remedies. Report to the Government of Bombay, 1910.
5. A note on the Edible Oyster written for the benefit of the Madras public. *M.F.B.* No. viii, 1916.

Chanks and Chank Fishery:

1. The Chank bangle industry. *Memoirs of the Asiatic Society of Bengal*, Vol. iii, No. 5, Calcutta, 1913.
2. The Sacred Chank of India. *M.F.B.* No. vii, 1914.
3. The Indian Conch (Turbinella) and its relation to Hindu life and Religion. Marine Zoology of Okhamandal, Part II, 1916.
4. The Indian varieties and races of the genus Turbinella (Chank). *Memoirs of the Indian Mueum*, Vol. vi, 1916.

Other Mollusca:

1. The anatomy of the Windowpane Oyster (Placuna). M.Z. of Okhamandal, Part I, 1909.
2. The utilisation of corals and shells for limeburning in the Madras Presidency. *M.F.B.* No. viii, 1916.
3. The edible Molluscs of the Madras Presidency. *M. F. B.* No. xi, 1916.
4. A review of the Indian species of Meretrix (one of the Clams). *Records of the Indian Museum*, Vol. xiii, Part iii, 1917.
5. The common Molluscs of South India. *M.F.B*, No. xiv, 1921.

Fishes and Fishing:

1. Report on the feasibility of operating deepsea fishing boats on the coasts of Madras Presidency. *M.F.B.* No. iv, 1908.
2. The results of a fishing cruise along the Malabar coast and the Laccadive islands in 1908. *M. F.B.* No. iv, 1908.
3. Report to the Government of Baroda on the Marine Zoology of Okhamandal, 2 vol, 1909 and 1916.
4. Marine Fishfarming for India. *M.F.B.* No. vi, 1911.
5. Note upon two exploratory cruises in search of trawl grounds of the Indian and Ceylon coasts. *M.F.B.* No. viii, 1916.
6. A new Protozoan cause of widespread mortality among marine fishes. *M.F.B.* No. xi, 1917.
7. A statistical analysis of the fishing industry of Tuticorin. *M. F. B.* No. xi, 1917.
8. The Indian Bechdemer industry, its history and recent revival. *M.F.B.* No. xi, 1917.
9. Report on the further development of the fishery resources of Baroda State, 1918.
10. The Fisheries of Norway and Denmark. *M.F.B.* No. xiv, 1921.

11. The flying-fish fishery of the Coromandel coast and the spawning habits of Cypsilurus. *M.F.B.* No. xv, 1922.
12. A contribution to the lifehistory of the Indian Sardine (jointly with M. Ramaswamy Nayudu). *M.F.B.* No. xvii, 1923.
13. The fishing methods of the Madras Presidency.
Part I—The Coromandel coast. *M F.B.* No. xviii, 1924.
Part II—The Malabar Coast. *M.F.B.* No. xxvii, 1938.
14. Report on the marine fisheries of Baroda State with suggestions for further development, 1930.

FISHING BOATS:

1. The Affinities of East African canoes. *Man*, 1919.
2. Les Piroques a Balancier de Madagascar et des l'afrique Orientale. *La Geographic*, Vol. xxxiv, No. 3, Paris, 1920.
3. The common origin of outrigger canoes of Madagascar and East Africa. *Man*, Vol. xx, No. 9, 1920.
4. The outrigger canoes of Indonesia. *M.F.B.* No. xii, 1920.
5. The origin and ethnological significance of Indian boat designs. *Memoirs of the A.S. of Bengal.* Vol. vii, No. 3, 1920.
6. Catamarans and reed rafts. *Man in India*, Vol. i, 1921.
7. The origin of the Chinese Junk and Sampan. *Man in India*, Vol. ii, 1922.
8. The Boats of the Ganges and fishing methods. *Memoirs of the A.S B.*, 8, 1924.
9. Water transport: Origins and Early Evolution. Cambridge University Press, 1946.

MISCELLANEOUS:

1. Three new Indian Cestodes. *Records of the Indian Museum*, Vol. vii, part ii, No. 18, 1912.
2. Description of a new species of Pinnotheres. M. Z. of Okhamandal, Part ii, 1916.
3. A Guide to the Madras Marine Aquarium, 1919. 2nd edition (enlarged) 1920 and IVth edition (revised), 1921.
4. The Madras Marine Aquarium. *M.F.B.* No. xiv, 1921.
5. The Madras Aquarium. *Journal of the Bombay Natural History Society*, Vol. xxviii, Part iii, 1922.
6. Some Commensals of Indian Alcyonarians and Crabs. *J. B. N. H. S.*, Vol. xxviii, Part iv, 1922.
7. Aims and achievements of Madras Fisheries department. *M.F.B.* No. xv, 5, 1922.
8. Some Biological problems of Marine Zoology in South India—Madras Handbook of the Indian Science Congress, 1922.
9. The use of fishmeal as food for livestock—a publicity leaflet.
10. Indian Boomerangs, Blowguns and Crossbows. *Journal of the Royal Anthropological Institute*, 44, 1924.
11. String figures of Gujarat and Kathiawar. *Memoirs of the Asiatic Society of Beugal*, 11, 4, 1932.

S. T. MOSES.

[In this issue appears the first part of Hornell's useful paper on the Study of Indian Molluscs which he wrote for the *Journal* some years ago and revised completely and shortly before his death—EDS.]

PROF. J. F. R. D'ALMEIDA

J. F. R. D'Almeida joined the biology staff of St. Xavier's College in 1915 during the time of the late Fr. E. Blatter, and has since been actively associated with botanical activities in Bombay. At his death he was the senior professor of the College and recognised by the Bombay University as a teacher in botany for M.Sc and Ph. D. students. He was also an examiner in I Sc., B.A., B.Sc.,

M.Sc., Chairman of the Faculty of Science and a Member of the Senate of Bombay University. In 1949, he was elected Vice-President of the Indian Science Congress, and has also been the President of the local centre of the Indian Ecological Society.

Outside botanical circles, Prof. D'Almeida did a lot of useful public work. For many years he served as a Municipal Councillor in Bandra and was Chairman of the Standing Committee. He was a member of the Bandra School Board, the District Local School Board, an Honorary Presidency Magistrate and a Justice of the Peace, etc., etc.

In 1917 he toured the High Wavy Mountains with the old stalwarts of the Society like Fr. Blatter and Mr. S. H. Prater for the collection of botanical material. His special interest in ferns and marsh plants is testified by the list of his publications appended. His numerous ex-students, and all those who had the privilege of working with him in Bombay will realize that Indian botany is distinctly the poorer by his death.

H. A.

PUBLICATIONS OF PROF. J. F. R. D'ALMEIDA

1. The Ferns of Bombay (jointly with Fr. Blatter).
2. The Indian Ophioglossums *Journ. Ind. Bot.* Dec. 1922.
3. A new species of fern from the High Wavy Mountains. *Journ. Ind. Bot. Soc.*, **5**(1), 1926.
4. Ferns of the High Wavy Mountains. Ibid. **5**(2), 1926.
5. A new species of Nephrolepis. Ibid. **5**(2), 1926.
6. Some notes on the structure and life-history of Nymphaea pubescens Willd. Ibid. **5**(2), 1926.
7. On the shoot morphology of Limnanthemum. Ibid. **7**(1), 1928.
8. Ferns of Waziristan. Ibid. **13**(2), 1934.
9. On the occurrence of Gymnogramne calomelanos Kaulf. in India. Ibid. **14**(3), 1935.
10. On the occurrence of adhesive tendrils in Bignonia venusta Ker-Gawl. *Jour. Bomb. Nat. Hist. Soc.*, 38, 1936.
11. A contribution to the study of the biology and physiological anatomy of Indian Marsh and aquatic plants. *Journ. Bomb. Nat. Hist. Soc.* Part I in vol. **42**, 1941 ; Part II in vol. **43**, 1942.
12. A contribution to the study of the ecological foliar anatomy of Indian Plants (jointly with J. L. Desai). *Journ. Bomb. Univ.* **10**, 1942.
13. A study of the stem anatomy of certain Indian climbing plants (jointly with P. Patil) Ibid. **14** (N.S.) Nov. 1945 and March 1946.
14. On the aerenchyma of Sesbania aculeata Poir. *Ind. Ecol.* **1**, 1946.
15. Observations on the ecology of Jussiaea suffritucosa L. and Ludwigia parviflora L. Ibid. **2**, 1947.
16. A contribution to the study of ecological anatomy of Indian Cyperaceae (jointly with C. S. Ramaswamy). Bomb. Univ. monogr. (in press 1948).
17. Root habits and anatomy (jointly with J. P. Correa, M.Sc. thesis 1945).
18. Extrastelar formations in plants (jointly with Mrs. Homai J. Moos, M.Sc. thesis 1947.
19 Anatomy of Cucurbitaceae (jointly with Miss Narges J. Khansaheb, M.Sc. thesis), 1947.

MISCELLANEOUS NOTES

1.—TIGER EATING PANTHER?

A friend informs me that while beating for woodcock in January 1946 beyond Hodgson's Hut on the Nilgiri Plateau, he came across a freshly killed female panther about two-thirds grown, from which a little had been eaten near the tail. Close by were the remains of a sambar stag with 30-inch horns which had apparently been killed by a tiger. On the panther were several claw marks, and when the skin was removed the carcase was found to be badly bruised. In addition she had received a heavy blow on the side of the head. The presumption is that the tiger returning to its kill had found the panther on it, and that the latter paid the penalty for her intrusion. It is a pity that further corroborative details are lacking, but on the face of it there does not seem much doubt as to what happened.

KALHATTI, NILGIRIS, E. G. PHYTHIAN-ADAMS,
14*th February* 1949. *Lt.-Col.*

2.—CHARGE BY UNWOUNDED BISON

Many years ago, I was endeavouring to obtain photos of a small herd of bison in the Mudumalai forest, and my very inadequate hand-camera necessitated so close an approach that at each attempt the animals were alarmed and bolted before I could secure a picture. After three abortive attempts my old Kurumba shikari Kempa advised me to give it up. 'You may move bison twice and sometimes three times without trouble', he said, 'but if you go on worrying them, they will turn nasty'. The old man's knowledge of wild animals was unrivalled, and I never knew him wrong, so rather unwillingly I abandoned further attempts to obtain photographs.

Since then I have repeatedly come across bison and have always found them timid and inoffensive—so much so that I have not the least hesitation in walking straight towards them in the open, and their re-action has invariably been to bolt after a good look. An example of this appears on page 326 of Vol. xl. But one never ceases to learn in the jungle, and on 2nd December 1948 an incident occurred which proved that old Kempa was perfectly correct, and that a bull may prove aggressive even though not fired at.

At the time we were after small game some 6 miles downstream of Anaikatti in the low country of the Nilgiris. The covert to be beaten was an isolated patch of jungle not of great extent, but heavily bushed. I was the centre gun and an open glade some 20 yards broad ran in a straight line on either side of me. Soon

after the beat started a peahen came out past the left gun who fired both barrels at it, and I then heard the beaters, who were still some 100 yards away, shouting that a bison was coming towards us. A few minutes later I heard it moving through the bushes in front. My rifle was lying on the ground close by, but I did not trouble to pick it up, as I had no reason to expect trouble, and so far as I knew there was no really fine head in that area. I did however, as a precautionary measure, move back a few yards towards a tree, at the foot of which my shikari Kunmada, and my chokra were sitting. Suddenly the bull's head appeared from the bushes about 25 yards away on my right front, I expected him to break past me on the right as he could easily have done. But after a good look at me he swung round, put down his head and charged straight at me. I nipped back behind the tree just in time and as he dashed past saw him make a vicious sweep with his horns, but luckily we were all under cover. Having made his point he carried on and disappeared. He was a young bull of deep chocolate colour, and his horns had a spread of not more than 30 inches if as much, but his bulk was very imposing as he rushed past literally within arm's length. As he charged, Kunmada shouted loudly at him, but without the least effect. This was no affair of a startled animal making a blind rush, such as any sportsman of experience will have seen time and again, but a deliberate head-down charge. He could have got away straight to his front, or to his left, without coming any nearer to us, but I suppose he thought that with the beaters shouting behind he was cornered. That seems to be the only explanation and it shows how the unexpected may occur in the jungle at any time—Kunmada told me that he had never known a similar case. It was extremely lucky for me that I had the tree handy. As it was, though he had to cover 25 yards to my 5, he nearly beat me to it!

KALHATTI, NILGIRIS, E. G. PHYTHIAN-ADAMS,
14th February, 1949. *Lt.-Col.*

3.—'DEATH CRY' OF TIGER

I have heard this peculiar sound twice, and in each case the tiger was dying from a liver shot.

The first was on the Nilgiri Plateau not far from Ootacamund in August 1929. A tigress had been wounded the day before by a friend who asked for my assistance in finishing her off. After a long search we located her in a very dense thicket of goatweed and brambles, in places over one's head and some 70 yards across. While my 2 dogs were baying her we endeavoured to find a way in but it was far too thick, so I climbed up a tree outside the thicket, and fired a number of 12 bore cartridges loaded with S. G. at the spot, not 25 yards distant, where the tigress appeared to be lying, so well as I could judge, in the hope of moving her. She answered to one of my shots—this was about 2-30 p.m. We

then withdrew a short distance to await the arrival of a herd of buffaloes which I had sent for, and about 3 p.m., S. and I heard a peculiar moaning noise come from the thicket, but as it was not repeated, we thought no more of it at the time. Half an hour later a Forest Guard arrived with the news that no buffaloes were available and suggested that as the tigress had not moved since 10 a.m. when we first found her, and was probably by now dead (she was believed to have received 2 body shots on the previous day from a ·500 H.V. rifle), he and 2 other men should cut a way into the thicket while we covered them. I did not much like the idea but there seemed no alternative. I first sent the dog in again (the other had been killed by the tigress earlier) and there were now no growls in answer to his furious barking, though the tops of the goatweed continued to move for some time after he became silent, and it seemed probable that he was worrying the body. So, to make a long story short we cut our way in, and found the tigress dead with a hind foot in her mouth bitten clean through. A post-mortem revealed that death was due to 3 buckshot which had entered her liver, and there can be no doubt that the curious noise we heard was her death cry. Of the shots fired the day before one had broken her right foreleg low down, and the other had inflicted a mere flesh wound in the left shoulder neither would of course have proved fatal, and the wonder is that a broken leg had anchored her to one spot for so long.

The second case was at Anaikatti in the Nilgiris low country in June 1940. The tiger, an old male of a very crusty disposition, refused to come out to the gun and broke back through the beaters. G, who was with them, fired as he passed hitting far back, and the tiger then entered some thick stuff before he had time for a second shot. Ten minutes later I heard what my diary describes as a 'prolonged moaning roar' and when I followed up after a standfast for half an hour, I found the tiger lying dead, and already covered with flies. The bullet, a soft nosed ·423, had entered far back, passed through the liver and was nicely mushroomed under the skin on the opposite side.

It is perhaps worth noting that in both cases death was due to a liver shot.

KALHATTI, NILGIRIS, E. G. PHYTHIAN-ADAMS,

14*th February*, 1949. *Lt.-Col.*

4.—FEEDING HABITS OF THE NILGIRI MARTEN

[*CHARRONIA GWATKINSI* (HORSFIELD)]

I was walking along a jungle path when I heard a slight sound and saw a marten going up a tree as hard as it could go. On looking at the foot of the tree I found the remains of a Malabar Squirrel (*Ratufa indica*) which had been dead for about a couple of days.

From marks on the skin and especially about the neck it is clear that the marten had killed it and was going to get every bit of meat off it.

The interesting thing about it was that the intestines of the squirrel had been neatly removed and lay about 6 feet away from it and the head also lay with them.

It is a known fact that martens kill small mammals but is it not unusual for one to (*a*) return to the same 'kill' even after two days had passed, and (*b*) to neatly remove the intestines and place them at a distance, presumably with the idea of the meat keeping longer without them?

I wonder if any of your readers have had a similar experience.

Martens are not uncommon in the High Wavy Mountains and I know of three pairs in one small area. In the Annamalai Hills however I have only once seen one late in the evening but cannot be sure about its identity as it may have been a Jerdon's Palm Civet (*Paradoxurus jerdoni*).

Injiparai Estate,
via Pollachi, A. F. HUTTON.
18*th February*, 1949.

5.—'AN ELEPHANT 170 YEARS OLD'

(Correction of a note published on p. 618, vol. 39 of the *Journal*.)

What age do elephants reach?

An answer to this question is contained in a recent article in the *P.Z.S.* vol 117, Pt. 4, pp. 680-88. (1948) by the late Major Stanley S. Flower, where he has come to the conclusion that 'there is not a single well authenticated record of either Indian or African elephants reaching the age of 70 years in spite of the many popular and journalistic exaggerations about the longevity of these elephants'.

In this study, Major Flower has gone into the available evidence in regard to the ages of well-known elephants such as 'Jumbo' and 'Alice' of the London Zoological Society, Napoleon's elephant 'Siam', 'Princess Alice' of Australia, all alleged to have lived for more than a hundred years. In every instance, the actual age as verified by him has been found to fall far short of the fantastic age quoted in the press and approximate rather to the 'three score and ten' average for Man.

'Jumbo' and 'Alice' said to have carried generations of London children were found to be actually 22-24 years of age. Besides, the names 'Jumbo' and 'Alice' have been associated by popular journalism in the last fifty years with individual elephants in menageries in Europe, America, Africa and Australia which have all been assumed to be identical with the original Jumbo and Alice of the London Zoo. 'Princess Alice' the popular Sydney circus elephant

claimed to have been 150 years old was only 23 on death when the facts were checked by Major Flower. Similarly 'Siam' the male Asiatic elephant, long believed to have been presented to Napoleon by a Turkish Pasha and who subsequently made it over to the Budapest Zoological Gardens is now established, on the evidence of Mr. F. A. Cerva, the well-known Hungarian ornithologist, Prof. O. Antonius, Director of the Schönbrunn Menagerie at Vienna and Dr. Tilly Edinger of the Museum of Comparative Zoology, Harvard, U.S.A., to have come direct to Vienna from Siam on 11-11-1897 as 'at most' a five-year old calf. Thus the report of its having belonged to Napoleon and attained an age of 150 years is a further example of journalistic exaggeration.

The case of 'Ortela' the 170-year old elephant from Ceylon, published in the *Times*, London of April 21, 1931 by Captain G. Dollman and reprinted in this journal was also investigated by Major Flower and is recorded as 'age unknown' in his table of alleged and actual ages given at the end of his present paper. 'Ortela' was a fully adult animal in 1656, according to Joao Ribeiro, author of 'Ceilao' (translated by Dr. Peiris) and was stated by Sir J. E. Tennent in his 'Natural History of Ceylon' (1861) as alive 'when the British flag was hoisted in Colombo in 1796'. Commenting on a passage later on in the same work that 'amongst the Singhalese the ancient fable of the elephant attaining to the age of 2 or 300 years still prevails; but the Europeans and those in immediate charge of tame ones entertain the opinion that the duration of life for about 70 years is common to both man and the elephant', Major Flower remarks that 'Tennent evidently regarded the great ages alleged to have been reached by some elephants as rare exceptions from the general rule, for he (Tennent) adds "of 138 elephants belonging to the Ceylon Government which died in the years 1831-1856 whose duration of life in captivity was recorded, only one reached the age in captivity of between 19 and 20 years".

Again, Tennent is quoted as mentioning an elephant of 'prodigious age, having been in the service of the Dutch and English Governments in succession for upwards of a century which died at Colombo in 1848. Her skeleton is now in the museum of the Natural History Society at Belfast'. With the help of this clue Major Flower was able to trace this skeleton, which was evidently Ortela's, and got Profs. A. J. E. Cave and Thomas Walmsley to examine it. The latter reported that the skeleton belonged to 'a female (from its general size and the size of the tusk holes; one tusk remains, but it is badly eroded)'. From the dentition and other skeletal details he concluded that she was not an aged beast.

Ortela's age of over 170 years does not thus seem to have any scientific basis and cannot be taken as established.

Bombay Natural History Society
114, Apollo Street, Fort,
Bombay,
10*th April*, 1949.

N. G. PILLAI,
Curator.

6.—A WHALE NEAR BOMBAY

An immature specimen of a rorqual, *Balaenoptera* sp. about 20′ in length was caught by fishermen on April 12, 1949, off the coast of Bombay and towed ashore to the Mahim Beach where it was exhibited to an interested public for a whole day and then returned to the sea as it was still alive.

The animal was of a bluish black hue above from snout to flukes, but pale white, below. The baleen, visible through the gape was flesh coloured in places. The upper lip appeared triangular from above and the eyes with their dark pupils were suggestive of a bullock's. An open sore about 3″ long and an inch wide was noticeable on the right lobe of the flukes which were kept covered by a rag. The fishermen emptied a bucket of cold water on to its back every now and then when the blowholes would bestir themselves into activity and let out deep breaths of air.

Rorquals, described to be the largest of all living animals, are whales which have whale-bone or baleen in place of teeth. Another group of whales called the right whales are also equipped with baleen, but the rorquals are readily distinguishable by their dorsal fins and the series of parallel grooves on the underside of their throat and chin, both of which are absent in the right whales. The name rorqual means 'the whale having folds or pleats'.

The baleen consists of a series of horny plates, roughly triangular in shape and a third of an inch thick, inserted by their short side along the lower edge of the palate at quarter inch intervals, at right angles to the long axis of the head. The inner side of each plate is frayed out and the frayed edges project into the mouth cavity where, all combined, they form an effective sieve for straining the water charged with food organisms.

Of the whales recorded from Indian waters, the rorqual has been the commonest. Adults reach a length of 100′, the largest one from the Indian coast being a 94-foot specimen from near Cherai, Cochin in November 1927. The present specimen is the third whale record for Bombay, according to the very useful list of cetaceans stranded on the coast of India, prepared by Dr. S. T. Moses of Baroda and published on page 378, (Vol. 47, No. 2) of this journal, and the second rorqual to be reported from this coast.

The rorquals are about 20-24 ft. when they are born, but grow very rapidly and attain a size of 60-65 ft. in three years becoming sexually mature at this age. The pairing season extends over several months and one to three calves are born at a time. The period of gestation is believed to be about 360 days.

Bombay Natural History Society
114, Apollo St., Fort,
Bombay,
14*th April*, 1949.

N. G. PILLAI,
Curator.

7.—UNRECORDED NESTING SITES OF THE GREY-HEADED FLYCATCHER [*CULICICAPA CEYLONENSIS CEYLONENSIS* (SWAINSON)].

In 1944, Mrs. Hayne of Halashana Tea Estate (alt. 5,000 ft. Nilgiris) a very keen bird watcher, and a friend saw one of these flycatchers in the tea flitting about the bushes and trees and then flying to a bank on the side of a path through the tea. After watching for about ten minutes they saw the bird disappear into the bank. The nest was very difficult to find as it resembled, very closely, the moss and lichen on the bank. It was about 3 feet from the ground and contained 3 eggs which duly hatched out. I was shown the exact spot where the nest was found. On one side of the path was a strip of low tree and bush jungle bordering a stream and on the other the bank and tea. Stuart Baker mentions nests being fixed to rocks but nothing about them being built in banks.

In view of what Stuart Baker and others have written, it may be of interest to record that on the same tea estate we saw a typical nest fastened to the trunk of a large rubber tree (*Ficus elastica* Roxb.) about 20 feet up, but quite close to the bungalow. The owners came and went to and from the nest quite regardless of the many people watching it.

KENILWORTH, CHAS. M. INGLIS,
COONOOR, NILGIRIS, F.Z.S., B.E.M.B.O.U.
7th April, 1949.

[It seems strange that this habit of nesting near human habitations should have been overlooked in previous descriptions. The Grey-headed Flycatcher is a familiar little bird at most W. Himalayan hill-stations, e.g., Mussoorie, and is commonly found nesting against the moss and lichen covered trunks of hill-oak and other trees in the compounds, frequently in the close proximity of inhabited bungalows.—EDS.]

8.—NIGHTJARS

I was interested to read, lately, Mr. Humayun Abdulali's letter, in No. 4 of Volume 47, of the *Journal*. Here, in Ceylon, we have three species of nightjars, all of which are attracted to the roads—both tarmac and unmetalled—in the hills as well as in the low-lands—though chiefly in the latter.

Personally, I am inclined to the belief that the chief reason for these nightjars haunting the roads is that the roads provide extended, open fields of view and nice level surfaces, away from cover, on which to settle and from which to make sorties, after night-flying insects.

Not only do nightjars haunt motor or cart roads but they may also be found on wide tracks and footpaths—for the same reason,

I think. Where roads pass through jungle and scrub, they form long open glades which attract moths and other night-flying insects and they afford to the nightjars long avenues up and down or over which they may fly while obtaining their food more easily than in places obstructed by bushes and undergrowth.

Many a time, I have watched nightjars alight on a road, sit for a few minutes and then fly up and over, presumably catching insects, before resettling in the vicinity of the place that they had just left. In fact, they behave in somewhat similar manner to a flycatcher, hawking insects from a favourite perch. It is a curious fact, which I have not seen recorded previously, that while the Indian Nightjar (*Caprimulgus asiaticus minor*) generally perches in the road, or on the tarmac, Horsfield's Ceylon Jungle Nightjar (*C. macrurus aequabilis*) usually sits on a stump, stone or dead branch at the side of the road and rarely settles on the middle or on the tarmac, if an alternative perch is available. Horsfield's Nightjar is rather the larger of the two and is a little less active—I have walked up to one dazzled by an electric-torch and grabbed it before it could fly away.

If there is too much traffic on a road, the nightjars will quickly desert it and seek a nearby glade or clearing on the boundary of the jungle or scrub, returning to the road when conditions are quieter. They always appear to gravitate to roads in the very early mornings, just as dawn is breaking, and to sit and call loudly for ten or fifteen minutes before retiring to their roosting places, in the scrub.

Only a few months ago, while I was working in my office at about 6.45 p.m. one evening, I observed a Ceylon Highland Nightjar (*C. indicus kelaarti*) fly past the windows. On going outside, I found that it had settled close by on the newly-spread, fine quartz gravel and was pecking round it, presumably picking up minute grains of the gravel on which it was sitting. It would seem probable, therefore, that some of our nightjars habitually pick up small particles of grit from the roads, with which to aid their digestion. Possibly this is the explanation of why they resort to the roads just before settling down to roost during the day.

Although the majority of our nightjars are credited with roosting on the ground, some appear to roost, sometimes, on the limbs of large trees. Some months ago, while examining through field glasses a small bird in a large gnarled tree growing in hillside 'park' land, I noticed a Highland Nightjar (*C. indicus kelaarti*) roosting along a large horizontal branch some 20 feet from the ground. The plumage of this nightjar blended in a remarkable manner with the rough, gnarled bark of the tree, making it almost impossible to distinguish it from above, although it was easy to see it when silhouetted against the foliage. Having found this nightjar on its roost, I looked for it each time I passed that way and for the next three weeks I found it—sometimes in the usual spot and sometimes roosting on a stump jutting out from another stout bough close by.

So, it would appear that sometimes, at any rate, this species of nightjar roosts on the upper side of large boughs in large trees

which possibly accounts, in part, for Legge's remark (Birds of Ceylon 1880—page 339). 'It is, however, more rarely flushed during the day than either of the following species, as it lies very close and does not repose in open spots like the Common Nightjar'.

GALAPITAKANDE ESTATE,
NAMUNUKULA, CEYLON, W. W. A. PHILLIPS
13*th January*, 1949.

9.—LUMINISCENT OWLS

The following account of a visit to a lake in Anatolia 30 years ago is from 'Forbidden Valley' by John Welman (Blackwood's Magazine, September 1948):

'A luminous blob appeared on a hillside far away and wavered fitfully like a bicycle lamp seen at a distance on a windy night. . . It swung round a clump of trees about 200 yards away, and came winging, swiftly and silently, towards us. It was a bird. At least, it had the shape of a bird, and flew; but surely no mortal bird ever glowed, as this one did, with the incandescence of a gas-mantle. It looked enormous, though I do not say it was; such sudden brilliance rushing headlong at one out of the ambient dark, may have exaggerated its real size. That it flew like a bird and shone like a lamp were more certain impressions accepted by my startled mind. And when it came nearer, I saw that every feather of its plumage glittered with tiny points of light, a kind of frosted fire which, without the power to dazzle, was bright enough to illuminate the branches of a tree through which it passed. Its wide, luminous wings seemed to beat the air without disturbing it, for they made no sound whatever. I found myself gripping Merrick's arm and cowering down as it approached looming bigger and brighter every instant, until, seeming about to fly right in among us, it swerved aside and shot up in an arc to pass above our heads.'

As a postscript to this it is said that even in England luminous Barn Owls have been known and reference is made to *The Zoologist* Vol. 66 of 1908 and *Transactions of the Norfolk Naturalists' Society* Vol. 8 of 1904-09.

The explanation given is that certain trees, particularly hollow ash trees are quite often infected by a phosphorescent fungus—*Armillaria mellea* or Honey Tuft. The feathers of a bird inhabiting such a hollow and infected tree become impregnated with fine particles of the decaying wood and so become luminous.

This is also recorded in 'The Handbook of British Birds' 3rd edition, Vol. II, p. 343 which reads—'rare but well authenticated instances of Barn Owls appearing luminous in dark are presumably due to luminous bacteria on feathers derived from decayed wood of hollow trees.'

This simple explanation of an apparently fantastic sight may lead us to hope that many of the equally and even more fantastic happenings recorded in India may be similarly explained. There is a lot of interesting information about luminiscence in living

creatures in 'Living Light' by E. Newton Harvey (Princeton University Press, 1940) in which reference is also made to old records of human and civet-cat urine being luminous. Any information from members on this subject would be interesting.

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay 3, HUMAYUN ABDULALI
15th January, 1949.

10.—WILSON'S STORM-PETREL (*OCEANITES OCEANICUS*) IN THE GULF OF ADEN

In his article 'The Storm-Petrels occurring in the Northern Indian Ocean and Adjacent Seas' in the *J.B.N.H.S.* Vol. 47, No. 3, Mr. Gibson-Hill states with reference to Wilson's Petrel that 'There are no certain records for the Indian Ocean proper north of latitude 40° South for November, except for a bird captured off Ceylon by Captain Fletcher in 1908, and it would seem that the main body of the migration has already passed below 50° south latitude'.

On 21st November 1935, I saw many of these birds in the Gulf of Aden not far from Cape Guardafui while on a course from the Straits of Perim to the Minicoy Channel, and I feel that the record is of such large numbers and the identification so satisfactory that it should be taken into account when trying to work out the movements of this species. The following is from my diary:—

'The mountains of Italian Somaliland could be seen through the haze on the starboard bow and we were eventually close enough to the barren-looking coast to be able to see a few palm trees and habitations. There was practically no wind and the sky was mainly overcast. It was a remarkable day as probably more birds were seen today than during the whole of the preceding part of the voyage. (We were then on the 20th day out of Liverpool). Wilson's Petrels were the commonest—many thousands being seen in the middle of the day when we were closest to the coast. It is difficult to explain why there were so many, as at this time they should be at their southern breeding stations. They were all drifting in a leisurely manner in a direction between east and north-east. Possibly they were birds from the Red Sea and Gulf of Aden gathered together to round Cape Guardafui on their way south (or even non-breeding birds) concentrated upon good feeding grounds. The latter idea is perhaps supported by the following:—There were many other birds present at the same time. Owing probably to currents going round the Cape the surface of the water was disturbed. The temperature of the sea water fell seven degrees and rose seven degrees in two hours during the forenoon suggesting that currents were forcing the deeper and colder waters to the surface causing an unusual concentration of marine life. Fish of all sorts were abundant on the surface ranging from 'boilings' of small things up to what the ship's officers termed 'dolphins, swordfish, giant squids, pilot fish and sharks'.

The Wilson's Petrels were not easy to identify. Only on about half a dozen occasions did I distinctly see the legs projecting beyond the tail although often I imagined that this was so. Once I actually saw the yellow webs when the bird was treading the surface directly below me and almost under the ship's cutwater. Often the birds would actually stand upright on the sea fanning their wings gently. When all in a big flock did this at the same time, as often happened, they looked at a distance like a party of much larger birds.

The next most common bird was a Phalarope, presumably the Red-necked *Lobipes lobatus*. Great compact flocks of these with numbers varying from 50 to several hundred were well distributed.

Quite a number of Dusky Shearwaters *Puffinus assimilis* were seen while Wedge-tailed Shearwaters *Puffinus pacificus* were not so numerous. About thirty or forty Blue-faced Boobies *Sula dactylatra* were seen flying towards Socotra and after the Cape about twenty or thirty Socotra Cormorants *Phalacrocorax nigrogularis* were also seen flying towards that Island. Unidentified birds were a party of terns and two gulls.

Thus until the afternoon when Cape Guardafui vanished from sight and the only land to be seen was a few islands on the horizon stretching away to Socotra, the surface of the sea was alive with birds.

The weather continued fine next day but in complete contrast not a single bird could be found and no more storm-petrels were seen on the rest of the voyage round Ceylon to the Hoogli River.

It is perhaps worth adding that on a voyage between the Straits of Perim and Bombay (when the ship's course keeps to the northern half of the Gulf of Aden) not a single Wilson's Petrel was seen. On this occasion we passed Aden on the 27th of November 1939 and arrived in Bombay on 2nd December so that apart from being right away from the turbulent waters around Cape Guardafui, we were also later in the season.

The nomenclature used is that of W. B. Alexander's 'Birds of the Ocean' (1928).

20 Inverleith Place,
Edinburgh, A. G. S. BRYSON.
15th December, 1948.

[Mr. C. A. Gibson-Hill comments on the above note as follows:—

'Mr. Bryson's record is most interesting. The value of summaries of existing published data is that they bring to light information not previously made public. This observation almost certainly discloses birds remaining in winter quarters during the southern summer. I suggest this possibility in the third paragraph on *O. oceanicus* in my paper, when trying to account for Maclaren's (1945) and my (1947) February records for the water north of Socotra. At the same time, in putting the idea forward, I did not feel that I could be too positive about it, in view of the extreme paucity of available records for the period. It may be that we have not heard more of Wilson's Petrel from the north-western corner of the Indian Ocean because it normally gets into

territory away from the usual steamer route. Presumably these birds were drawn to the neighbourhood of Cape Guardafui by the production of a good feeding ground. Thousands is unusual even for the months of maximum concentration. I remember noticing when off South Georgia, in January-March 1946, that though one usually saw a few petrels at all times, there were occasions on the whaling grounds when one would suddenly come on very great numbers, so that they seemed "as thick in the air as falling snow-flakes". An interesting point in connection with this is how well they really do fare under normal conditions in tropical waters. Possibly they run rather short of food, and to some extent subsist on their reserves, unless they come upon patches unusually rich in plankton. The general concensus of opinion is that the Whalebone Whales lose fat while in these seas. I do not think that Mr. Bryson's birds are likely to have been still on their way south. 21 November is late for them to be so far from their nearest breeding ground. In addition the clockwise circle round the Atlantic Ocean is so well authenticated that it must be accepted as the normal movement there, and from it one would expect something similar to be happening in the Indian Ocean. Such records as we have for the coasts of India and Ceylon (see also Humayun Abdulali, *J.B.N.H.S.*, Vol. 47, No. 3, p. 550) certainly support this.'—Eds.]

11.—OCCURRENCE OF THE BAR-HEADED GOOSE *ANSER INDICUS* (LATHAM) IN BOMBAY.

I was out walking with my dog about 8.30 a.m. on the morning of December 4th and went to the patch of beach by the Port Trust Flats in Colaba. As I was going down the incline to the beach I saw just about to settle by some mangrove bushes a large bird which I thought was a goose, and sure enough it was. I put my dog on the lead and got to within about 20 yards, close enough to see its eyes and head markings very clearly indeed. I stayed still for quite a few minutes and was able to have a very good look at the goose. It then rose slowly in the air and flew in my direction, quite close to me, and went off seawards round the end Port Trust Flats in the direction of Sassoon Dock. I went home and at once looked up my plates of Indian geese and duck, published by the Natural History Society and it was without doubt a Bar-headed Goose.

Colaba, Bombay, (Mrs.) KAY NIXON BLUNDELL
9th December, 1948.

[The Bar-headed Goose has not been recorded before from Bombay or along the West Coast. It is however fairly generally distributed in the Deccan and goes as far south as Mysore, Coorg and Coimbatore. The species has been seen on the Godavari River near Nasik (Sálim Ali, *J.B.N.H.S.* xxxvii, p. 454).—Eds.]

12.—OCCURRENCE OF THE WHITE-FRONTED GOOSE *ANSER ALBIFRONS* SCOP. IN ORISSA

On the 12th December I shot a goose on Nalban Island in the Chilka Lakes which according to Stuart Baker, Finn, Pitman and illustrations from Peter Scott is undoubtedly the White-front.

The bird agreed entirely with the description and the following details were noted at the time :—

1. *Bill*: Orange with a white bill nail. White mask starting about ¾ inch above the bill and continuing down to below lower jaw.
2. *Chest and abdomen*: Much darker and prominent lateral markings than those of the Grey Lag.
3. *Head, shoulders and back*: Darker than a Grey Lag.
4. *Legs*: Orange red and more orange than a Grey Lag.
5. *Size*: Smaller than a Grey Lag.

I have subsequently had a look at the sketches of the White-front and the Dwarf Goose in the *Journal*, Vol. 47, page 478, and my bird was certainly the White-front.

The bird was one of a pair that passed over me in the afternoon and was coming into Nalban island after the innumerable large gaggles of Grey Lags had left the island consequent to the morning's shooting. In a bag of 23 Grey Lags it was conspicuously different in size and colour.

These 2 birds and 2 Bar-heads were the only geese I saw come into the island after midday by which time all the Grey Lags had betaken themselves to safer places.

Subsequent to this I have been again to the Chilka and it may be of interest to record that the thousands of Grey Lags that were on Nalban in mid-December had dwindled to a few gaggles by early January and their numbers had been replaced, but not quite to the same extent, by Bar-head of which species there were a mere handful on the first occasion.

Another (to me) interesting fact was that whereas the duck that predominated on Nalban was the Wigeon, on another island less than a mile away, shot next day, there was hardly a Wigeon to be seen and Gadwall formed the majority of the bag. Our ubiquitous friend the Shoveller was in large quantities on both. The two islands seemed exactly alike as to the soil and growth thereon.

Looking up old game books I notice that up to 15 years ago Pintail predominated in the bag on Chilka. Among 350 duck shot on the Chilka during this and the past season only 14 Pintail are recorded and we generally have a sweep on the first Pintail ! !

1, WOODBURN ROAD, L. A. CRAVEN
CALCUTTA 20,
19*th January*, 1949.

[The White-fronted Goose breeds from Lapland through Northern Europe to Western Siberia. In winter it migrates south to all Europe, Northern Africa, India, Burma and China. In India, it appears in the north-west (now Pakistan) almost every year in

small numbers, and also across Northern India to Assam and Manipur. One of five was shot on the Ganges, near Kanpur, U.P. on 25th January 1908 (*J.B.N.H.S.*, xviii, p. 683). Mr. Craven's record from Orissa is the southernmost in India.

Mr. Craven's remarks regarding the relative abundance of Grey-lags and Bar-heads were passed on to Sir Edward Benthall who has recorded his experiences with geese at the Chilka Lake in the *Journal*, Vol. 47, p. 168. He writes 'I have certainly noticed variations between the populations of Grey-lags and Bar-headed geese in different years, but if anything, my evidence is rather contrary to that of Mr. Craven'. He agrees that more information should be obtained before any definite statement can be made regarding the movements of these geese.

The predominance of different species of duck at different butts is well-known. The gun near a shallow and weedy pool is likely to have a larger percentage of common teal and shovellers in his bag, than another stationed on an islet in the midst of deep water. Our knowledge of the food and feeding habits of duck in India is very limited, and any definite information in this respect would be valuable.—Eds.]

13.—THE BRONZE-CAPPED TEAL IN ASSAM

The editors' note on Mr. Robey's record of the Bronze-capped Teal (*Eunetta falcata*) at p. 749 of Vol. 47 of the *Journal* tends to exaggerate its rarity in Assam. It is certainly a straggler, but a not uncommon one. Between December, 1908, and February, 1943, I saw 82 shot, on 53 occasions.

The majority of these birds, 67 in number, were obtained in Manipur. There they figured in the bag in 18 years. The best bag in any one year was 13, in 1932–33, and the best day was 8, out of a total bag of 187, in February, 1941. The Assam Valley, where I shot far less often, provided 14 birds, from ten different localities, in the districts of Lakhimpur, Sibsagar, Nowgong and Kamrup. In the Surma Valley, where I only shot duck twice, I bagged 1 (out of 80 duck) in the Sylhet district.

In Manipur the Bronze-capped teal formed 0·16 per cent of the total bag of duck, or 1 in 600; in the Assam Valley, 0·33 per cent or 1 in 300.

Males in full plumage are uncommon, with the result that many of this species must be overlooked when the bag is examined. I only identified my first through wondering why a Gadwall duck should have grey legs and proceeding to investigate further with the help of Stuart Baker's book.

Alford,
Lincolnshire,
23rd January, 1949. J. C. HIGGINS

[The Crested or Falcated Teal has the upper and lower tail-coverts very long, extending beyond the tips of the rectrices. The

females of this and the Gadwal look very much alike; but the former species has fourteen tail feathers, the latter sixteen.

Other distinguishing characters are :—

Gadwal :—

(*a*) Legs and feet yellow.
(*b*) Visible portions of inner secondaries pure white.

Falcated Teal :—

(*a*) Legs olive-grey or olive-brown; feet black.
(*b*) Visible portions of inner secondaries black with white edges.—EDS.]

14.—THE TUFTED DUCK [*AYTHYA FULIGULA* (LINN.)]: AN INTERESTING ADDITION TO THE AVIFAUNA OF CEYLON

I have received from Mr. H. G. Panditteseker a, of Chilaw, the wing of a drake Tufted Duck, shot by him on 4th February 1949, at Amanapahua Tank, near Dandagamuwa in the North Western Province of Ceylon. It was one of the 30 or 40 feeding, in scattered parties of 10 or 12, on the tank which was partially covered with lotuses, waterlilies and sedges.

This forms a most interesting record; the Tufted Duck has never hitherto been recorded from Ceylon and it is of rare occurrence even in South India.

GALAPITAKANDE ESTATE, W. W. A. PHILLIPS
NAMUNUKULA,
18*th February* 1949.

15.—THE GREAT CRESTED GREBE [*PODICEPS CRISTATUS* (LINN.)] IN ORISSA

During the last week of December 1946 I was staying in Puri, and on three occasions I visited a large freshwater pool not much more than a mile from the sea, which is the haunt of ducks, terns and other waterfowl. Among the most conspicuous swimming birds were several Great Crested Grebes, some eight or ten in all. They did not keep together, but they were usually swimming and diving near the bank and they did not take alarm when duck were being shot at. It would be interesting to know if they are regular visitors to this pool. The latitude seems to be nearly the same as, or even a little farther south than, the recently recorded Great Crested Grebes in Kathiawar (see *J. B. N. H. S.*, antea, Vol. 47, p. 385).

24, RAJPUR ROAD, H. G. ALEXANDER
DELHI,
26*th February* 1949.

[The above constitutes the southernmost record of the species in peninsular India, though it comes down to about the same latitude (ca 20°N.) in the Southern Shan States, Burma.—Eds.]

16.—'THE BIRDS OF DELHI AND DISTRICT'

Mr. N. F. Frome in his article in your issue Vol. 47, No. 2 invites additional data to his most interesting paper. I succeeded to Sir Andrew Clow's garden in 1942 and was resident there until 1946, revisiting the area in 1947. I send herewith notes on a few species not recorded in the area and some very brief remarks on others mentioned by Mr. Frome.

Otocompsa jocosa (Linnaeus). Red-whiskered Bulbul.
This species was certainly commoner in 1946 than in 1942.

Muscicapa parva (Bechstein). Red-breasted Flycatcher.
My latest record was April 7th.

Tchitrea paradisi (Linnaeus). Paradise Flycatcher.
Nested in the Safdar Jang Horticultural Gardens.

Lusciniola melanopogon (Temm. and Laug.)
Moustached Sedge-Warbler. I watched a pair of birds in my garden on May 9th for some minutes, obviously migrating, and could only identify them as this species. The record is, however, probably doubtful.

Munia malacca (Linnaeus). Chestnut-bellied Munia.
A pair were watched for twenty minutes eating grass seeds in company with a party of White-throated Munias in my garden on July 8th, 1945.

Gymnorhis xanthocollis (Burton). Yellow-throated Sparrow.
Used to visit kikar trees in my garden in considerable flocks in mid-June and July each year, individuals hawking for flies. (Observed with Mr. J. D. Michael). Similar flocks seen on the Lodi Golf Course.

[P. S.—I watched these birds for many hours when they collected towards dusk in the kikar trees, but although they corresponded in every respect to the yellow-throated sparrow, I was not able for certain to observe the yellow throat. On some specimens I imagined I saw this but should not care to swear to it owing to the yellow light of the evening. Neither Mr. Michael nor I could identify them as anything else.]

Megalaima zeylanicus (Gmelin). Green Barbet.
Nested in 1945 and 1946 in a tree-hole in my garden, the nest hole being subsequently occupied in July of 1945 by a pair of Brahmany mynahs.

Caprimulgus monticolus (Franklin). Franklin's Nightjar.
A large number noted on May 18th near Surajkund.

Hieraëtus fasciatus (Vieillot). Bonelli's Eagle.
One was shot for pigeon marauding by a householder in New Delhi.

Crocopus phoenicopterus (Latham). Common Green Pigeon.
A pair nested at the top of a kikar in my garden from May 29th to June 11th. It was a mystery how the sitting bird could keep her seat as the *loo* blew strongly, and eventually the nest was blown out.

Porphyrio poliocephalus (Latham). Purple Moorhen.

Seen on February 2nd at the Horseshoe Jhil. Others seen in the neighbourhood but outside the 30 mile circle.

Coturnix coromandelicus (Gmelin). Rain Quail.

A pair, which I hoped might nest, spent a week in the dried-up flower beds on my lawn from June 8th to 15th.

Perdicula asiatica (Latham). Jungle Bush Quail.

Two shot near Sohna on November 26th.

Francolinus francolinus (Linnaeus). Black Partridge.

Common in a marshy area below Okhla in June in 1946 and 1947 where none seen in the winter.

Porzana pusilla (Pallas). Baillon's Crake.

Seen not infrequently in snipe jhils. One picked up dead on Oct. 22nd.

Burhinus oedicnemus (Linnaeus). Stone Curlew.

I should have said were fairly common or common. A pair hatched two chicks after 18 days' minimum incubation and reared one in my garden.

Esacus recurvirostris (Cuvier). Great Stone Plover.

Nested two years on islands in the Jumna.

Glareola maldivarum (Forster). Large Indian Pratincole.

Seen fairly frequently on the Jumna. On June 15th, 1946 I approached to within 15 yards of a flock of about 300 Large and 3 Little Indian Pratincoles.

Recurvirostra avosetta (Linnaeus). Avocet.

Commoner than reported by Mr. Frome. In 1946 seen April 7th (one) May 12th (seven), May 26th (one) and June 22nd (two) on the Jumna.

Limosa limosa (Linnaeus). Black-tailed Godwit.

One record on May 26th

Tringa nebularia (Gunnerus). Greenshank.

One record as late as May 26th.

Philomachus pugnax (Linnaeus). Ruff and Reeve.

Seen not infrequently; one in May.

Erolia alpina (Linnaeus). Dunlin.

Latest date seen May 17th.

Leptoptilos dubius (Gmelin). Adjutant.

Four feeding with White-backed Vultures on a carcase at Loni on October 1st, 1944, pecking with great deliberation over the backs of the vultures.

Ixobrychus cinnamomeus (Gmelin). Chestnut Bittern.

Solitary bird seen twice in marsh below Okhla in June.

Dendrocygna javanica (Horsfield) Lesser Whistling Teal.

I saw one shot on November 2nd at Shahdara.

Casarca ferruginea (Pallas). Ruddy Sheldrake.

Latest date seen May 12th.

Marmaronetta angustirostris (Ménétries). Marbled Teal.

I shot a solitary bird on the Horseshoe Jhil on January 25th, 1947. This was identified by several people as I was specially interested, not having seen the bird in Northern India before.

Anas querquedula (Linnaeus). Garganey Teal.

I should say very common at times on migration. In, I think, early October 1942 there were large numbers, nearly all males, on Gurgaon Jhil; I saw also on this occasion about 200 netted birds, hardly any of which were females. As late as March 29th, 1943, there were large numbers of males and females on a jhil near Nuh. I have also records as late as May 2nd (one) and June 15th (nine) on the Jumna.

Spatula clypeata (Linnaeus). Shoveller.

A solitary male noted on Jumna on May 5th and 2 males and 4 females on May 12th.

Aythya rufa (Linnaeus). White-eyed Pochard.

Common at times on jhils near Delhi (outside the 30-mile circle), but only once observed within the circle, on March 15th near Okhla.

Aythya fuligula (Linnaeus). Tufted Pochard.

Only record on March 15th near Okhla, at the same time and place as the above.

CALCUTTA,
23rd February, 1949.

E. C. BENTHALL,
K.C.S.I.

During the past three years I have spent in the aggregate several months in Delhi, at various seasons of the year and have done a certain amount of bird-watching, all of it in the immediate vicinity of the city, apart from occasional visits to Okhla. The following notes supplement the valuable compilation by N. F. Frome published in the *Journal* (Vol. 47, pp. 277–300) and the supplementary notes in the August (1948) number, p. 751.

I divide this note into two sections : the first deals with species not included in Mr. Frome's list; the second with notes that seem to modify or supplement his statements about the status of certain species.

1. The following are the species I have identified satisfactorily that are not in the list :

Acrocephalus agricola Jerdon. Paddyfield Warbler.

Seen in rushes by Jumna, 20 April 1949. Very like *A. scirpaceus* of Europe, but its reddish tinge is diagnostic.

Franklinia gracilis (Franklin). Franklin's Wren-Warbler.

It is perhaps the commonest Wren-Warbler on the Ridge at Old Delhi, but I have not noted it elsewhere.

Prinia sylvatica Jerdon. Jungle Wren-Warbler.

I have noted in tall *sarpat* grass in July near New Delhi ; also, more doubtfully, on the Ridge.

[**Phylloscopus neglectus** Hume. Plain Willow Warbler.

Twice (in March 1928 and in November 1946) I have seen a small brown phylloscopus in company with *P. collybita* which appeared to be shorter in the tail and slightly different in coloration. *P. neglectus* seems to be indicated, but I do not know the species, so it is probably wiser to keep the square bracket.]

Dissemurus paradiseus (Linn.). Racket-tailed Drongo.

Captain Ronald saw one in late February or early March 1949 in New Delhi.

Pitta brachyura (Linn.). Common Pitta.

Has recently (Feb. 1949) been seen by several observers in New Delhi.

Emberiza huttoni Blyth. Grey-necked Bunting.
Saw a small party on the Ridge at Old Delhi in April 1949.

Motacilla feldegg Mich. Black-headed yellow Wagtail.
Noted in March.

Alauda arvensis Linn. Skylark.
Several were flying about near the river below Humayun's tomb on Jan. 1st, 1948.

Circus pygargus Linn. Montagu's Harrier.
Identified near the Jumna in April.

Larus brunneicephalus Jerdon. Brown-headed Gull.
One on Jumna sand bank, April 18th, 1947.

Sterna hirundo Linn. Common Tern.
Several with other terns over flood water north of Delhi, Sept. 12th, 1948. Subspecies uncertain.

Gelochelidon nilotica (Gmelin). Gull-billed Tern.
One by the river below Humayun's Tomb, April 18th, 1947.

Charadrius leschenaultii Lesson. Large Sand Plover.
One by River Jumna, 8 May 1949.

2. The following amplifications of Mr. Frome's papers appear to be worth publishing :

Saxicola torquata (Linn.). Stone-chat.
Recorded by Frome from mid-November. I saw one on 1st September 1948.

Musicapa parva Bechstein. Red-breasted Flycatcher.
Frome records it as 'not at all common'. In my experience it is fairly plentiful as a passage migrant, in November and in March-April, but it is easily overlooked unless one is familiar with its unmusical little trill.

Acrocephalus dumetorum Blyth. Blyth's Reed-Warbler.
In my experience a common passage migrant in April and September.

Hippolais caligata Licht. Booted Warbler.
Also an abundant passage migrant, at least in spring (February to April). On 18 April 1947, as on 20 April 1949, the small hedges by the river were alive with them.

Sylvia hortensis (Gmelin). Orphean Warbler.
Noted on New Delhi golf course, 1st January 1948.

Phylloscopus griseolus Blyth. Olivaceous Willow-Warbler.
One at Old Delhi, September 10th, 1948.

Phylloscopus humii (Brooks). Hume's Willow-Warbler.
Abundant throughout the winter.

Phylloscopus trochiloides (Sundevall). Greenish Willow-Warbler.
Abundant on migration, especially in September, when its song can sometimes be heard.

Ploceus bengalensis (Linn.). Black-throated Weaver Bird.
The colony at Okhla, referred to as *P. manyer* is in fact of this species. This colony was first shown to me by Mr. R. S. Symons in 1946. In 1948 I visited it again in August, and had very good views of the birds.

Amandava amandava (Linn.). Red Munia.
I saw large parties going to roost north of Okhla in August 1948.

Emberiza stewarti Blyth. White-capped Bunting.
I have seen a few on the Ridge between November and April.

Falco chicquera Daudin. Red-headed Merlin.
Seen in August and other months on the Ridge.

Circus macrourus (S. G. Gmelin). Pale Harrier.
One, 25th September 1948.

Circus aeruginosus (Linn.). Marsh Harrier.
One, 12th September 1948.

Turnix dussumieri (Temm. and Laug.). Little Button Quail.
I have twice walked into one near the Jumna in April.

Recurvirostra avosetta (Linn.). Avocet.
Single birds noted several times by the Jumna.

Limosa limosa (Linn.). Black-tailed Godwit.
Probably a regular visitor. Noted by the Jumna in May 1946, some fifty by flood water north of Delhi, September. 13th, 1948 ; ten flying up and down the river at Okhla, February 18th, 1949.

Philomachus pugnax (Linn.). Ruff.
Noted in April, May and September.

Erolia temminckii (Leisler). Temminck's Stint.
A common passage migrant in September and April.

Ixobrychus cinnamomeus (Gmelin). Chestnut Bittern.
Seen on a swamp near Okhla in June, 1946. This and one or two of the other records here noted in May and June 1946 were seen in the company of Sir E. Benthall.

24 Rajpur Road, Delhi H. G. ALEXANDER
26th February, 1949.

17.—THE DAWN CHORUS IN INDIA

There is some justification for the popular assertion that in comparison with the English countryside the plains of India lack bird-song. Though certainly fewer really beautiful songsters are to be heard, the volume and variety of sounds produced in the early summer mornings are as great as ever at home, as these notes made just before I left the country will show. I was sleeping then in a small mango grove in a typical part of the United Provinces. The monsoon was about to break, and night temperatures used not to fall below 90°F.

0420	(I.S.T.).	King-crows start chattering.
0425	,,	Koels and House-crows call in the distance.
0430	,,	A Golden Oriole whistles a few bars.
0432	,,	The family of Spotted Owlets which lives in the mango-grove squabbles softly before retiring for the day.

0434	(I.S.T.)	Red-vented Bulbuls sing.
0435	,,	A Crow-pheasant mounts a mango-tree and begins its *coop-coop-coop*.
0436	,,	Common Mynahs burst into loud gossip.
0437	,,	The Golden Oriole's charming whistle is drowned by the donkeys in the transport lines braying to be watered.
0440	,,	Increased noise from the house-crows, mynahs, koels, bulbuls and crow-pheasants.
0445	,,	Two Night Herons squawking loudly return to roost above my bed.
0450	,,	Rose-ringed Paroquets call preparatory to flying out to feed.
0452	,,	A Tickell's Golden-backed Woodpecker laughs rudely from a tree-trunk within a few feet of my bed.
0502	,,	A Tailor-bird sings a note or two from near its nest high in the mango-tree.
0515	,,	The mynahs fly off to forage, still chattering ceaselessly.
0520	,,	The *hudhud-hudhud* of a Hoopoe breaks through the persistent cawing of the crows.
0525	,,	A party of Seven Sisters (Babblers) trails past my bed, maintaining contact by low cries and mutterings.
0535	,,	Sun-up.
0540	,,	The mynahs, orioles, crows and koels are by now well awake and preparing for another noisy day.

"LOENWETH"
ST. FEOCK, TRURO,
CORNWALL, ENGLAND.

P. I. R. MACLAREN,
M.B.O.U.

18.—BIRD NOTES FROM KUTCH

About the middle of January 1949, while shooting Houbara in the dunes of Mundra District in Luni we saw masses of duck in the open shallow stretch of coast in the Gulf of Kutch. Owing to the slush and mud we could not get nearer than about a thousand yards but watched them carefully through binoculars. They were teal and heavy duck. We could not identify the species. Normally this is not a migration period and ordinarily duck here are not known to settle in such large numbers in the open sea. Mr. S. A. D. Naoroji and Major S. A. Azim were shooting with me that day.

Records by former Political Agents mention Imperial Grouse as having been seen and shot in the western districts of Kutch. Records kept by my grand-father and father for close on a century indicate that they have not been known as regular winter visitors in the western half of Kutch but only in eastern districts. My own experience extending over a number of years shows that they are

gradually receding further east. In the last 10 years since the famine year of 1939–40, I have only found them trickling into the easternmost parts of Kutch in winter. I hope like the Grey-lag geese they will not by-pass Kutch altogether in years to come.

BHUJ, MAHARAO MADANSINHJI
7th February 1949.

19.—HERPETOLOGICAL OBSERVATIONS IN ASSAM AND BENGAL (1944)

The following are some records and notes based on observations made during my military service, the writing up of which, I regret, has been long delayed. The period of my stay in each of the places mentioned below did not exceed about two months and, in addition, opportunities for observations of this kind were restricted. In view of this, therefore, it does not necessarily follow that, in cases where only one specimen was found, the species is uncommon or rare in that particular locality.

REPTILIA—SAURIA

Calotes mystaceus Dum. and Bibr.

Locality: Near Kohima (Naga Hills), Assam.

A single specimen taken on 8th June, 1944. Although known to occur in Burma (Smith, 1935), this appears to be the first record of the species in Assam.

Ptyctolæmus gularis Peters.

Locality: Near Kohima (Naga Hills), Assam.

A single specimen taken on 27th May, 1944. Wall (according to Smith, 1935) records it common round about Shillong in the Khasi Hills at 4,500 feet. Its occurrence in the Naga Hills, therefore, is to be expected, though I am not aware of any previous records.

REPTILIA—SERPENTES

Natrix xenura (Wall) Smith.

Locality: Near Kohima (Naga Hills), Assam.

A single specimen taken on 30th May, 1944. This is a very rare snake in collections and only four other specimens are known, three of which came from Cherrapunji in the Khasi Hills, Assam, the type having been lost (Smith, 1943). Details of the specimen in my collection have already been published (Romer, 1945).

AMPHIBIA—SALIENTIA

Philautus (*Ixalus*) *vittatus* (Boulenger).

Locality: Near Kohima (Naga Hills), Assam.

A number of specimens observed in June, 1944. These frogs were found sitting on rushes, a small patch of which were growing

in shallow water on some cultivated land. The rushes grew to about three feet in height and the frogs, when closely approached, had a tendency to jump downward towards the water. When forced to do so they swam quite well, though did not seem keen to enter the water. Observations were made only during daylight hours, however, and the frogs may have been more aquatic in habit after dark. Two females taken on 7th June, 1944 each contained a mass of eggs which could be seen through the very thin and transparent abdominal wall. The larger of these measured 25 mm. from snout to vent.

The only reference to this species at present available to me (Boulenger, 1890) gives the habitat merely as 'Bhamo, Upper Burma.'

Rana leptoglossa (Cope) Boulenger.

Locality: Mymensingh, Eastern Bengal.

About a dozen of these frogs, all of which were males, were encountered during August, 1944 on some wet ground where water had collected to a depth of several inches; they were all in the same spot, within a few feet of each other. The ground was well covered with grass and other vegetation which provided good cover for small amphibia. My attention was drawn to these frogs by their croaking, which was heard continually, night after night, and sounded somewhat like the noise made by a few quick strokes with a file or rasp, this being emitted at regular intervals of a few seconds.

This species was known to occur in Assam, Burma, Tenasserim, Siam and Tonkin (Boulenger, 1920), though apparently not in Bengal.

Bufo melanostictus Schneider.

Locality: Near Kohima (Naga Hills), Assam.

One pair found in amplexus and the female depositing spawn in an irrigation ditch on 18th May, 1944. Length, snout to vent: ♂ 60 mm.; ♀ 108 mm.

There is no doubt that the breeding season of this species may be very protracted. The following quotation (McCann, 1932) is of particular interest in this respect:—'In the Naga Hills (Assam), I found these creatures breeding from January to March.'

Kaloula pulchra Gray.

Locality: (? Jogandranagar) near Mymensingh, Eastern Bengal.

Two interesting specimens were taken on 6th July, 1944 from amongst the vegetation by the side of a small stagnant pool. In combination of morphological characters and coloration neither of these conformed with either of the two subspecies, i.e., *pulchra* and *taprobanica*, described by Parker (1934). In one specimen the dark median dorsal area which covers most of the back is broken up by large, irregularly shaped markings of a yellowish red colour, bordered with black (as in *taprobanica*), yet the web between the third and fourth toes does not extend distally beyond the level of the proximal subarticular tubercle of the fourth toe (as in *pulchra*). In the other specimen the above is reversed, i.e. the dark median dorsal area is not broken up by lighter markings, yet the web between the third

and fourth toes extends beyond the proximal subarticular tubercle of the fourth toe. These two specimens are now in the British Museum (Natural History).

It has already been pointed out by Parker (1934), writing of *taprobanica*, that: 'Specimens from Calcutta appear to be intermediate between this race and the typical form; the webbing of the toes is similar to that of Siamese specimens but the colour pattern is that of the Ceylon subspecies.' Since the geographical range of each subspecies extends to Bengal, it is not really surprising that intermediate forms are to be found there, but it would be interesting to know over how great an area such forms occur.

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— — — 1943. —do— —do— Vol. III.

c/o MEDICAL DEPARTMENT,
HONG KONG,
26*th October*, 1948.

J. D. ROMER,
F.Z.S.

20.—EXTENSION OF RANGE OF THE EARTH SNAKE *UROPELTIS RUBROLINEATUS* (GÜNTHER)

In September 1948 I obtained an earth snake at Bhimshankar in the Western Ghats, (alt. 2,500 feet) about 80 miles north-east of Poona. As it did not fit the identification key ('ventral scales 165–172') given by Dr. Malcolm Smith in his revision of the Fauna of British India series on Reptilia and Amphibia (Vol. iii, 1943, p. 82), the specimen was forwarded to him for confirmation.

He writes:

'The Uropelt of your letter to me of October 1, is undoubtedly *U. rubrolineatus*. My description in the Fauna is drawn up from 3 specimens and no doubt a larger series would show a bigger variation in the ventral count. The specimen you sent has 135—a big drop—and it may be that specimens from the Poona district may have a lower ventral count'.

The distribution as given in the Fauna is: 'India. Western Ghats, south of the Palghat Gap, Anaimalai and Travancore Hills'. The present locality therefore marks a considerable northward extension.

33 PALI HILL, BANDRA,
BOMBAY 20,
14*th February*, 1949.

SÁLIM ALI

21.—FRESHWATER SHARK (*WALLAGONIA ATTU*) SWALLOWING A COOT

Fishing in Lake Beale, Nasik Dt., in February 1949 I caught, on a plug, a wallago. It was 4′ 2½″ long and although I was unable to weigh it, the weight may be taken as in the region of 20 lbs.

The fish had a large bulge in its stomach and on opening it up I found inside a full-grown coot, recently swallowed.

The voracious appetite of the wallago is well-known, but I had not previously heard of its including waterfowl in its diet.

MACMILLAN BUILDING,
276, HORNBY ROAD, R. S. COOPER
BOMBAY,
11*th February*, 1949.

[Several sportsmen shooting regularly on Lake Beale have complained of dead duck disappearing before they could be picked up from the water. The culprit would now seem to have been traced.

Jordan ('Fishes', 1925, p. 401) mentions a record of a small child swallowed whole by another member of this voracious family of Old World Catfishes, namely the Sheatfish or Wels (*Silurus glanis*) of Europe, which attains a weight of 300 to 400 lb.—EDS.]

22.—ACCIDENTAL ASPHYXIATION OF A FRINGE-LIPPED CARP (*LABEO FIMBRIATUS*) [1]

On 7–10–1946, at about 9 a.m., a large specimen of the common carp, *Labeo fimbriatus*, was found dead in one of the ponds in the Chetput Fish Farm, Madras. The fish was lying on its side among the marginal grass, fully under water, with the head towards the margin. A closer examination showed that a specimen of the pond catfish *Mystus vittatus*—also dead—was stuck up in its mouth. The carp measured 24 inches in total length, 7 inches in height of body and weighed 6 pounds and 12 ounces—an excellent size and weight for the species. It was a male with the testes in the third stage, was in fine condition, and the fresh appearance and healthy bright red colour of the gills indicated that it was not long since death took place.

The head and pectoral fins of the catfish were inside the mouth of the *Labeo*, with the hinder part of the body projecting out. It measured 4·5 inches in length and weighed 15 gms. The bright colour of its gills indicated that it was also dead only since a short while. The strong dorsal spine of the catfish had pierced the upper lip of the carp anteriorly and from inside. Similarly the right pectoral spine had deeply pierced the anterior part of the left cheek of the carp, also from inside. The left pectoral spine was free, but it

[1] Published with the kind permission of the Director of Industries and Commerce, Madras.

got stuck up when an attempt was made to take out the catfish by a gentle pull from behind.

While it is difficult to say how exactly the catfish came to find itself in the above predicament, the habits of the two fish seem to suggest what actually could have taken place. Both the fish are non-predators. The carp *L. fimbriatus* frequents the bottom and marginal areas, nibbling at debris and ooze. The catfish *M. vittatus* also generally confines itself to the bottom and has the characteristic habit of moving about very actively in all directions. It is likely that while the carp was feeding at the bottom it suddenly came upon the catfish, which, caught unawares and probably frightened, made a wild rush to get away in the direction which, unfortunately for both, happened to be towards the carp which received it straight into its mouth. The subsequent frantic struggles of the catfish to extricate itself and the carp's attempts to eject the intruder would easily result in the spines of the catfish becoming embedded in the mouth parts of the carp. Normal respiration would thus have become impossible and in a short while the carp would have died of asphyxiation. The catfish, in its desperate attempts to extricate itself from the unnatural position, would have also soon died of exhaustion.

Catfish spines are reported to be poisonous.[1] However, instances are on record where the pectoral spines of the allied species *M. gulio* have been found to have pierced the stomach of fish but without any poisonous effects.[2] It is therefore, likely that the spines of *M. vittatus* are also not poisonous and that in the present instance the death of the carp was really a case of asphyxiation, which is noteworthy owing to the extraordinary circumstances under which it took place.

K. H. ALIKUNHI

Freshwater Biological Research Station,
Government Fisheries, Madras,
24*th August*, 1948.

[Fatalities due to suffocation among fish endeavouring to swallow other fish are not uncommon and there are innumerable instances of fish dying in this manner. The present case resulting in the death of a non-predaceous fish may be an accident as suggested.—Eds.]

23.—THE BUTTERFLY GENUS *DELIAS*

With reference to Mr. Parsons' remark in his note on *Delias descombesi leucacantha* (1948, *Journal Bombay Natural History Society*, 47 : 555) that the species's immunity from attack in all stages may be due to the distasteful qualities of the food-plant, there are records of polyphagous larvae having been found to be distasteful to predators when feeding on ivy and palatable when feeding on other plants, but

[1] Bhimachar, B.S., *Proc. Ind. Acad Sci.*, 19, B, 1944, pp. 65–70.
[2] Menon, P.M.G., *Curr. Sci.*, 17, (5), 1948, pp. 155–157.

there are not, so far as I am aware, any records of such immunity being carried through to the imago. I am at present separated from my library and so cannot give any references.

There are several species of Lycaenidae and also of Hemitheid Geometers which are also *Loranthus*-feeders, and these are almost certainly readily attacked as imagines. The Pieridae in general, and the genus *Delias* and the closely allied African *Mylothris* Hbn. in particular, are usually thought to be protected species, the two genera *Delias* and *Mylothris* providing a number of models for mimicry associations. The members of *Mylothris*, incidentally, are mostly *Loranthus*-feeders.

My own experience with a batch of *D. descombesi* pupae, also found in Shillong, was similar to Mr. Parsons', a large proportion of them dying. It must be remembered that lepidopterous larvae often suffer severely from virus diseases, and that, whilst aposematic larvae such as *Delias* gain in protection from their increased conspicuousness when gregarious, they have to pay the price by running a greater risk from virus disease due to this same gregariousness.

Finally I would draw Mr. Parsons' attention to my series of papers on the Early Stages of Indian Lepidoptera, in one part of which he will find a detailed description of the pupa of *D. descombesi leucacantha*. The pupae of both *Delias berinda berinda* and *D. berinda boyleae* are described in other parts.

NAIROBI, D. G. SEVASTOPULO,
19*th October*, 1948. F.R.E.S.

24.—ADDITIONAL NOTES ON ARAKAN BUTTERFLIES

I feel that Major Emmet has admirably amplified my own work on Arakan Butterflies. What a pity that he and I should not have met except in the pages of this journal!

It appears that much of our work was complementary, for between us we have worked the country through every month of the year and while I concentrated mainly on the low-lying coastal strip, Major Emmet seems to have spent more time in the hills and the jungle that clothes them. It is not surprising that many of the butterflies in the additional list are essentially jungle species, or those occurring only from July to November.

There are some surprising gaps in these lists. For instance, neither of us met *Precis orithya ocyale* Hub., or *Vanessa cardui* L., both easily recognised and elsewhere widely distributed and common; nor were *Eurema libythea* F., and *Eurema laeta sikkima* M., recorded. The yellows might have been overlooked while flying with others of the genus, but particular attention was paid to all the *Eurema*e seen, resulting in the discovery of the ♀ *E. lacteola sarinoides* Fruh., and several interesting specimens of *E. hecabe hecabe* L. Were we to spend another year in Arakan working in co-operation, not independently as before, these and other questions might be answered and the list brought nearer to completion.

I append some additional notes on points arising from Major Emmet's list and from further study of my own specimens.

(6) A 4-2. **Papilio memnon agenor** L.

I cannot agree that November sees the last of this butterfly; indeed, my own acquaintance with the species is restricted to the period November to June, during which it was continually observed although the females were little in evidence.

My experience of *P. memnon memnon* L., in Java, although not strictly relevant, is of a rapid succession of generations, with but five to six weeks interval between the laying of the egg and the emergence of the imago. 'Staggered' ovipositing, coupled with this short life cycle, combined to make emergence a daily occurrence throughout the months February to May covered by my breeding experiments. I found three ♀ forms, roughly corresponding to those mentioned by Evans, of which the tailed form represented about half the total ♀♀. The total number of ♀♀ emerging in my cages was about equal to that of ♂♂.

11. A 4-27 β. **Papilio demoleus malayanus** Wall.

Talbot, (Fauna of British India, Vol. 1, 2nd edition) says that intermediate forms between *demoleus* and *malaynus* occur where the ranges of the two overlap.

My specimens from Ramree Island and also those from Rangoon, appear to refer to *malayanus* and are in no way intermediate in form. Those from farther north are identical with specimens from Peninsular India. Major Emmet has encountered only *demoleus* but it would be interesting to know whether he noticed any development towards *malayanus*.

(19) B 6-11. **Delias descombesi leucacantha** Fruh.

Mr. Parsons' description of *descombesi*, (Vol. 47, No. 3, p. 554) was most interesting although no mention was made of the relative frequency of the ♂ and ♀.

The species that I bred in Java was not *descombesi*, but the very similar *D. belisama belisama* Cr. The early stages and habits of *descombesi* as described by Mr. Parsons are identical with those of the Javanese *belisama*; they even seem to die from similar causes!

(170) C 3-7γ **Euploea core vermiculata** But.

(45) C 3-7 δ **Eupioea core layardi** Druce.

My specimens of *E. core* shew a wide variation in the development of the spots upf. There may be a full set of prominent post-discal and sub-marginal spots as in *E. core coro* Cr., from Peninsular India. At the other extreme the sub-marginal spots are obsolete from 4 to the apex, the post-discal much reduced, with those in 4 and 5 obsolescent. In all forms the apical post-discal spots are approximately equal in size.

All have the basal 2/3 upf dark velvety brown with a very faint purple-blue gloss, the outer 1/3 being paler and not glossed, with traces of discal spots on the costa and base 3.

These specimens are from Teknaf and Ramree Island and would all seem to refer to *E. core layardi* Druce.

(50) C 3-17 β **Euploea klugii klugii** M.

This species is also very variable in the upperside markings. Upf discal spots may be prominent or obsolescent and vary in number from none to a full set. Post-discal spots may be complete, or obsolete either apically or tornally. Sub-marginal spots complete, or obsolete apically. Uph spots are small and usually obsolescent. In ♀♀ the termen is nearly straight; in ♂♂ prominently convex in the region of the brand.

(63) F 2-2 γ. **Eriboea athamas athamas** Dr.

(188) F 2-3 **Eriboea arja** Fd.

I find, with dismay, that my specimens of *athamas* are, in fact, examples of *E. arja*. As they were all taken in low-lying ground, Major Emmet's remarks on the distribution of these species is in no way contradicted.

MANCHESTER, ENGLAND,
12*th November*, 1948. JOHN C. GLADMAN,
B.SC.

25.—THE BUTTERFLY *DANAUS CHRYSIPPUS* IN CALCUTTA

On p. 771 of the August (1948) issue of the *Journal* in the article 'The Biology of *Danaus chrysippus*. L.' I see that Mr. Sevastopulo mentions that he never found the imago of either f *alcippus* Gr. or *dorippus* Klug. in Calcutta. I was an amateur butterfly collector as a lad and certainly had four specimens with very definite white lower wings which Mr. E. P. Stebbing at the Indian Museum identified as form *alcippus*. I collected these in the Society's garden at Alipore. These four specimens were obtained over a period of five or six years and then, as I lost my collection through the carelessness of a servant and the voracious appetites of the red ant, I discontinued collecting.

S. PERCY-LANCASTER,
Secretary.

THE ROYAL AGRI-HORTICULTURAL SOCIETY OF INDIA,
1, ALIPORE ROAD, ALIPORE, CALCUTTA,
15*th December*, 1948.

[Mr. Sevastopulo comments on the above as follows:

'The *alcippus* form of *Danaus chrysippus* has been recorded from India in the past and is quite unmistakable; it just happens that I have never come across it, in spite of the fact that I must have bred and caught the species in hundreds, if not in thousands.

Mr. Lancaster's record is obviously a fairly old one and it is quite possible that *alcippus*, which is always rare in India, may have had a colony in the Alipore gardens, which has since become extinct. I am not sure of the genetic relationship between *alcippus* and the type form, but I expect it is recessive, and there may be some antipathy between the two forms so that cross-pairings are rare; under such circumstances it is easy to understand that a small colony of the mutation might rapidly disappear.'—EDS.]

26.—CHIRONOMID MIDGES IN SOUTHERN TIBET

(*With a photograph*)

Between 9th and 14th May 1946 I collected a number of midges beside Hram *Tso* (lake), at 14,700′ on the treaty route from Phari Dzong to Gyantse and Lhasa.

The insects were hatching in vast quantities in the extensive marshes south and east of the lake, and were blown across the water to the opposite shore, where for miles on end they formed banks up to thirty yards wide and one to two inches deep, (*vide* accompanying photograph). Up to two hundred yards from the water millions of insects lay in the shelter of every stone and depression, and rose in swarms around passing men and animals.

Specimens were submitted to the British Museum (Natural History), where the Keeper of Insects reported that they belonged

to an apparently undescribed species of *Chironomus* very similar to the European *C. pilicornis* Fab. The species was mentioned in the literature by Dr. F. W. Edwards in 1928 in his account of some

Nematocera from Yunnan and Tibet (*Ann. Mag. N. Hist.* (10) 1 : 684) but his specimens could not be traced. As those which I sent to the British Museum were damaged in transit, travellers on the Lhasa route should be on the watch for this insect; they would perform a useful service by collecting further specimens so as to allow the species to be properly described.

FISHERIES STATION,
LAGOS, NIGERIA.

P. I. R. MACLAREN

27. BEE *V.* SCORPION

On 11th October 1942, a friend and I were beating for small game up the Magadi Road, some 10 miles out of Bangalore. I was sitting down waiting for a beat to commence, when my attention was drawn to a large bee repeatedly diving at the short grass in front of a lantana bush a few yards away. On investigation I found that the object of attack was a large scorpion, whose claws would be seen working above the grass. It did not appear to be feeding on anything, so I imagine it was merely trying to protect itself from the attacks of the bee. But I have often wondered what possible bone of contention could have existed between two such unlikely antagonists. Perhaps some reader may be able to offer a solution?

KALHATTI, NILGIRIS,
14*th February*, 1949.

E. G. PHYTHIAN-ADAMS,
Lt.-Col.

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PART II—BIRDS

O = Birds—General Ornithology.

Os = Birds—Shikar and Sport.

OPr = Birds—Popular.

OFR = Fauna of British India Series (Birds). Reference volumes; not lent out.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
					Abdulali, Humayun	(*See* Ali Sálim & Abdulali, Humayun.)
1	O	32	2	A	Ali, Sálim and Abdulali, Humayun	THE BIRDS OF BOMBAY & SALSETTE, 1936.
2	O	33	2	A	do.	do. do.
3	O	55	2	A	Ali, Sálim	THE BIRDS OF KUTCH, 1945.
4	O	56	2	A	do.	THE BOOK OF INDIAN BIRDS, 3rd Edition, 1944.
5	O	57	2	A	do.	THE BOOK OF INDIAN BIRDS, 4th Edition, 1946.
6	O	236	4	E	do.	BIRDS OF MYSORE, CENTRAL INDIA, BAHAWALPUR, (bound serials 1940-1942).
7	O	237	4	E	do.	BIRDS OF BOMPAY, 1948. (Bombay Citizenship Series No. 2, Edited by Bulsara, Dr. J. F.)
					do.	(*See* Kinnear, N. B., Whistler, Hugh, & Ali, Sálim.)
8	Os	188	2	F	Alpheraky, Sergius	THE GEESE OF EUROPE & ASIA, BEING THE DESCRIPTION OF MOST OF THE OLD WORLD SPECIES, 1905.
8A	O	324	4	C	Armstrong, Edward A.	BIRD DISPLAY—AN INTRODUCTION TO THE STUDY OF BIRD PSYCHOLOGY, 1942.
9	O	156	2	D	Armstrong, John S.	HAND-LIST TO THE BIRDS OF SAMOA, 1932.
10	O	110	2	C	Aymar, Gordon C.	BIRD FLIGHT, 1936.
11	O	94	2	B	Baker, E. C. Stuart	INDIAN DUCKS AND THEIR ALLIES, 1908.
12	O	95	2	B	do.	INDIAN PIGEONS AND DOVES, 1913.
13	O	46	2	A	do.	A HAND-LIST OF GENERA & SPECIES OF BIRDS OF THE INDIAN EMPIRE—Reprint from the *Journ. B. N. H. S.*, 1923.
14	O	127	2	C	do.	THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE, Vol. I, *Corvidae—Cinclidae*, 1932.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
15	O	128	2	C	Baker, E. C. Stuart	THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE, Vol. II, *Turdidae—Sturnidae*, 1933.
16	O	129	2	C	do.	THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE, Vol. III, *Ploceidae—Asionidae*, 1934.
17	O	130	2	C	do.	THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE, Vol. IV, *Pandionidae—Podicepidae*, 1935.
18	Os	161	2	D	do.	GAME BIRDS OF INDIA, BURMA & CEYLON (DUCKS & THEIR ALLIES), Vol. I, 1921.
19	Os	162	2	D	do.	GAME BIRDS OF INDIA, BURMA & CEYLON (SNIPE, BUSTARDS, SAND-GROUSE), Vol. II, 1921.
20	Os	163	2	D	do.	GAME BIRDS OF INDIA, BURMA & CEYLON (PHEASANTS, BUSTARD-QUAIL), Vol. III, 1930.
21	Os	164	2	D	do.	GAME BIRDS OF INDIA, BURMA & CEYLON (TRAGOPANS, QUAIL, PARTRIDGES, ETC.), Vol. IV, bound serial, 1919–1925.
22	Os	165	2	D	do.	GAME BIRDS OF INDIA, BURMA & CEYLON (WADERS & SEMI-SPORTING BIRDS), Vol. V, bound serial, 1926-1935.
23	O	202	2	E	do.	CUCKOO PROBLEMS, 1942.
24	O	205	2	E	do.	NESTS & EGGS—NOTES ON THE NIDIFICATION OF SOME INDIAN BIRDS NOT MENTIONED IN HUME'S 'NESTS & EGGS' (A paper published in '*The Ibis*' IN 3 PARTS), 1895.
25	OFR	301	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. I, 1922.
26	OFR	302	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. II, 1924.
27	OFR	303	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. III, 1926.
28	OFR	304	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. IV, 1927.
29	OFR	305	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. V, 1928.
30	OFR	306	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Vol. VI, 1929.
31	OFR	307	7	A	do.	FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—BIRDS, 2nd Edition, Synonymy, Vol. VII, 1930.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
32	OFR	308	7	A	Baker, E. C. Stuart	Fauna of British India including Ceylon & Burma—Birds, 2nd Edition, Synonymy (contd.) Corrigenda & Addenda & Alphabetical Index, Vol. VIII, 1930.
33	OFR	309		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. I, 1922.
34	OFR	310		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. II, 1924.
35	OFR	311		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. III, 1926.
36	OFR	312		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. IV, 1927.
37	OFR	313		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. V, 1928.
38	OFR	314		Mus.	do.	Fauna of British India including Ceylon & Burma—Birds, Vol. VI, 1929.
39	OFR	321	7	C	do.	The Fauna of British India—Birds, including Ceylon & Burma, 2nd Edition, Vol. I, 1922.
40	O	47	2	A	Baker, Lt.-Col. H. R. & Inglis, C. M.	Birds of Southern India, (including Madras, Malabar, Travancore, Cochin, Coorg & Mysore), 1930.
41	O	27	2	A	Barnes, Lt. H. E.	Handbook to the Birds of the Bombay Presidency, 1885.
42	O	28	2	A	do.	do. do.
43	O	29	2	A	do.	do. do.
44	O	30	2	A	do	do. do.
45	O	31	2	A	do.	do. do. 1897.
46	O	37	2	A	Bates, Capt. R. S. P.	Bird Life in India, 1931.
47	O	38	2	A	do.	do.
48	O	7	4	F	Bendire, Capt. Charles	Life Histories of North American Birds with special reference to their breeding habits & eggs—Smithsonian Institution—U. S. National Museum, Spl. Bulletin, 1892.
49	O	8	4	F	do.	do. do.
50	O	297	2	F	Berg, Bengt	Die Liebesgeschichte Einer Wildgans, 1930.
51	O	150	2	D	Bewick, T.	A History of British Birds, Land Birds, Vol. I, 1921.
52	O	151	2	D	do.	A History of British Birds, Water Birds, Vol. II, 1921.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
53	OFR	317	7	C	Blanford, W. T.	FAUNA OF BRITISH INDIA—BIRDS, INCLUDING CEYLON & BURMA, Vol. III, 1895.
54	OFR	318	7	C	do.	FAUNA OF BRITISH INDIA—BIRDS, INCLUDING CEYLON & BURMA, Vol. IV, 1898.
					Bonaparte, Prince Charles Lucien	(*See* Wilson, Alexander & Bonaparte, Prince Charles Lucien.
					Bonhote, J. Lewis	(*See* Hartert, Ernst J. O. & Bonhote, J. Lewis.)
55	O	160	2	D	Bready, Marcia Brownell	THE EUROPEAN STARLING ON HIS WESTWARD WAY, 1929.
56	O	298	2	F	Brehm, A. E.	LA VIE DES ANIMAUX--LES OISEAUX.
57	O	149	2	D	Buller, Walter L.	MANUAL OF THE BIRDS OF NEW ZEALAND, 1882.
58	O	114	2	C	Burton, Richard F	FALCONRY IN THE VALLEY OF THE INDUS, 1852.
					Butler, Arthur G.	(*See* Seth-Smith, David & Butler, Arthur G.)
59	O	322	2	E	Chance, Edgar	THE CUCKOO'S SECRET, 1922.
60	O	134	2	C	Chasen, Frederick Nutter	A HAND LIST OF MALAYSIAN BIRDS, Bulletin of the Raffles Museum, Singapore, 1935.
61	O	19	4	F	Chenu, Dr.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. I.
62	O	20	4	F	do.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. II.
63	O	21	4	F	do.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. III.
64	O	22	4	F	do.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. IV.
65	O	23	4	F	do.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. V.
66	O	24	4	F	do.	ENCYCLOPEDIE D'HISTOIRE NATURELLE—OISEAUX, Vol. VI.
67	O	126	2	C	Chubb, Charles	STRAY FEATHERS—A Journal of Ornithology for India and its Dependencies, Vol. XII, Systematic and General Index to Vols. i—xi, 1899.
68	O	65	2	A	Coues, Prof. Elliott	HANDBOOK OF FIELD & GENERAL ORNITHOLOGY—A Manual of the Structure & Classification of Birds with instructions for collecting & preserving specimens, 1890.
69	O	193	2	E	Dalgliesh, Gordon	FAMILIAR INDIAN BIRDS, 1907.
70	O	71	2	B	Darling, F. Fraser	BIRD FLOCKS & THE BREEDING CYCLE: A Contribution to the Study of Avian Sociality, 1938.
71	O	234	4	E	Deignan, H. G.	THE BIRDS OF NORTHERN THAILAND, Smithsonian Institution Bulletin 186, U. S. National Museum, 1945.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
72	O	291	2	F	Delacour, J. & Jabouille	Les Oiseaux de l'Indochine Francaise, Tome I, 1931.
73	O	292	2	F	do.	Les Oiseaux de l'Indochine Francaise, Tome II, 1931.
74	O	293	2	F	do.	Les Oiseaux de l'Indochine Francaise, Tome III, 1931.
75	O	294	2	F	do.	Les Oiseaux de l'Indochine Francaise, Tome IV, 1931.
76	O	64	2	A	Dewar, Douglas	Birds of the Indian Hills, A companion volume to the bird volumes of 'The Fauna of British India,' 1915.
77	O	103	2	C	do.	Indian Birds (A Key to the Common Birds of the Plains of India), 1910.
78	O	192	2	E	do.	Birds of an Indian Village, 1924.
79	O	190	2	E	do.	Birds at the Nest, 1928.
80	O	191	2	E	do	do. do.
81	O	194	2	E	do.	A Bird Calendar for Northern India, 1916.
82	Os	177	2	F	do.	Game Birds (with wood engravings by Daglish, E. Fitch), 1928.
					do.	(*See* Wright, R. G. & Dewar, Douglas.)
83	O	136	2	C	Dresser, H. E.	A Manual of Palæarctic Birds, 1902.
84	O	34	2	A	EHA (Edward Hamilton Aitken)	The Common Birds of Bombay, 2nd Edition.
85	O	35	2	A	do.	do. do.
86	O	36	2	A	do.	The Common Birds of India, 3rd Edition, 1947.
87	O	300	6	A	Elliot, Daniel Giraud	A Monograph of the Paradiseidæ or Birds of Paradise, 1873.
88	O	70	2	A	Fairbank, Rev. Henry	Birds of Mahableshwar, 1921.
89	O	62	2	A	Finn, Frank	Garden & Aviary Birds, 1906.
90	O	63	2	A	do.	How to know the Indian Ducks, 1901.
91	O	69	2	A	do.	The Waterfowl of India & Asia, 1909.
92	O	104	2	C	do.	The World's Birds. A simple and popular classification of the birds of the world, 1908.
93	O	113	2	C	do.	Contribution to the Theory of Warning Colours & Mimicry—A collection of reprints from the Journal, Asiatic Society of Bengal, 1895.
94	Os	178	2	F	do.	Indian Sporting Birds, 1915.
95	Os	179	2	E	do.	The Game Birds of India & Asia, 1911.
96	Os	199	2	E	Finsterbusch, C. A.	Cock-fighting all over the World, 1929.

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97	O	159	2	D	Fisher, A. K.	The Hawks & Owls of the United States, in their relation to Agriculture, U. S. Dept. of Agriculture, Bulletin No. 3, 1893.
98	O	39	2	A	Fletcher, T. B. & Inglis, C. M.	Birds of an Indian Garden, 1924.
99	O	40	2	A	do.	do. do.
100	O	41	2	A	do.	do. 2nd Edition, 1936.
101	O	42	2	A	do	do. do.
102	O	107	2	C	Friedmann, Herbert	The Cowbirds. A Study in the Biology of Social Parasitism, 1929.
103	O	249	4	E	Gadow, Hans	Catalogue of the Birds in the British Museum, *Cichlomorphae*, Part V, Vol. VIII, 1883.
104	O	250	4	E	do.	Catalogue of the Birds in the British Museum, *Cinnyrimorphae*, Vol. IX, 1884.
105	O	158	2	D	Gedney, C. W.	Foreign Cage Birds.
106	O	233	2	E	Gibson-Hill, C. A.	British Sea Birds, 1948.
107	O	154	2	D	Gillespie, T. H.	A Book of King Penguins, 1932.
108	OPr	197	2	E	Gladstone, Hugh S.	Birds & The War, 1919.
109	OPr	196	2	E	Gordon, Douglas	The Pageant of Wings, 1938.
110	O	217	2	G	Gould, John	The Birds of Asia, Vol. I, Parts 1-6, 1850-1854.
111	O	218	2	G	do.	The Birds of Asia, Vol. II, Parts 7-12, 1855-60.
112	O	219	2	G	do.	The Birds of Asia, Vol. III, Parts 13-18, 1861-66.
113	O	220	2	G	do.	The Birds of Asia, Vol. IV, Parts 19-24, 1867-72.
114	O	221	2	G	do.	The Birds of Asia, Vol. V, Parts 25-30, 1873-77.
115	O	222	2	G	do.	The Birds of Asia, Vol. VI, Parts 31-35, 1869-73.
116	O	223	2	G	do.	A Century of Birds from the Himalaya Mountains, 1832.
117	O	323	7	C	Gray, George Robert	The Genera of Birds, 1849.
118	O	97	2	B	Greene, W. T.	Parrots in Captivity, Vol. I, 1884.
119	O	98	2	B	do.	Parrots in Captivity, Vol. II, 1884.
120	O	99	2	B	do	Parrots in Captivity, Vol. III, 1887.
121	O	210	3	F	Hachisuka, The Hon. Masauji	The Birds of the Philippine Islands with notes on the Mammal Fauna, Galliformes to Pelecaniformes, Parts 1 and 2, Vol. I, 1931-1932.
122	O	211	2	F	do.	The Birds of the Philippine Islands with notes on the Mammal Fauna, Accipitriformes to Passeriformes, Parts 3 and 4, Vol. II, 1934-1935.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
123	O	259	4	D	Hargitt, Edward	Catalogue of the Birds in the British Museum, (Picidae), Vol. XVIII, 1890.
124	O	111	2	C	Harington, Major H. H.	Notes on the Indian Timeliidae & their Allies (Laughing Thrushes & Babblers), 1914-15.
125	O	143	2	D	do.	The Birds of Burma, 1909.
126	O	208	2	F	Hartert, Ernst J.O. & Bonhote, J. Lewis	Proceedings of the Fourth International Ornithological Congress, London, forming, Vol. XIV of the 'Ornis', 1905.
					Hartert, Ernst	(*See* Salvin, Osbert and Hartert, Ernst.)
127	O	203	2	E	Harting, James Edmund.	The Birds of Shakespeare, 1871.
128	O	109	2	C	Heilmann, Gerhard	The Origin of Birds, 1926.
129A	O	11	4	F	Henry, G. M.	Coloured Plates of the Birds of Ceylon, Parts 1-3.
129B	O	325	4	C	Hickey, Joseph J.	A Guide to Bird Watching, 1943.
130	O	106	2	C	Higham, Walter E.	Birds in Colour, 1946.
131	O	290	2	F	Hodges, R. H. W.	Common British Birds and How to Identify Them, 3rd Edition, 1919.
132	O	72	2	B	Holmer, M. N.	Indian Bird-Life, A Book for Bird Study, 1923.
133	O	241	4	E	Horsfield, Thomas & Moore, Frederick	Catalogue of Birds, E. I. Co. Museum, Vols. I & II, 1854.
134	O	198	2	E	Horton-Smith, C.	The Flight of Birds, 1938.
135	O	204	2	E	Howard, Eliot H.	Territory in Bird Life, 1920.
136	O	25	4	F	do.	The British Warblers, A History with Problems of their lives, Parts 2-5, 7, (incomplete) 1908-12.
137	O	26	4	F	do.	An Introduction to the Study of Bird Behaviour, 1929.
138	O	152	2	D	Hudson, W. H.	British Birds, 1918.
139	O	227	4	E	Hume, Allan	The Nests & Eggs of Indian Birds, 2nd Edition. Edited by Oates, Eugene William, Vol. I, 1889.
140	O	228	4	E	do.	do. Vol. II, 1890.
141	O	229	4	E	do.	do. Vol. III, 1890.
142	O	60	2	A	do.	My Scrap Book or Rough Notes on Indian Oology & Ornithology, Part I, Raptores, 1869.
143	O	61	2	A	do.	do. do.
144	O	115	2	C	do.	Stray Feathers, A Journal of Ornithology for India and its Dependencies, Vol. I, 1873.
145	O	116	2	C	do.	do. Vol. II, 1874.
146	O	117	2	C	do.	do. Vol. III, 1875.
147	O	118	2	C	do.	do. Vol. IV, 1876.
148	O	119	2	C	do.	do. Vol. V, 1877.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
149	O	120	2	C	Hume, Allan	STRAY FEATHERS, A Journal of Ornithology for India and its Dependencies, Vol. VI, 1878.
150	O	121	2	C	do.	do. Vol. VII, 1878.
151	O	122	2	C	do.	do. Vol. VIII, 1879.
152	O	123	2	C	do.	do. Vol. IX, 1881.
153	O	124	2	C	do.	do. Vol. X, 1882.
154	O	125	2	C	do.	do. Vol. XI, 1888-89 (For Vol. XII General Index—*see* Chubb, Charles).
155	Os	166	2	D	Hume, Allan & Marshall, C. H. T.	THE GAME BIRDS OF INDIA, BURMA & CEYLON, Vol. I, 1879.
156	Os	167	2	D	do.	do. Vol. II, 1880.
157	Os	168	2	D	do.	do. Vol. III, 1881.
158	Os	169	2	D	do.	do. Vol. I, 1879.
159	Os	170	2	D	do.	do. Vol. II, 1880.
160	Os	171	2	D	do.	do. Vol. III, 1881.
161	O	58	2	A	Hume, A. O.	CONTRIBUTIONS TO INDIAN ORNITHOLOGY No. 1, Cashmere, Ladak, Yarkand, 1873.
162	O	200	2	E	Huxley, Julian	BIRD-WATCHING & BIRD BEHAVIOUR, 1930.
					Inglis, C. M.	(*See* Baker, Lt.-Col. H. R. & Inglis, C. M.)
					do.	(*See* Fletcher, T. B. & Inglis, C. M.)
					Jabouille, P.	(*See* Delacour, J. & Jabouille, P.)
163	O	230	4	E	Jardine, William	THE NATURAL HISTORY OF HUMMING-BIRDS, Vol. I, 1840.
164	O	231	4	E	do.	do. Vol. II, 1840.
165	O	74	2	B	Jerdon, T. C.	THE BIRDS OF INDIA, Vol. I, 1862.
166	O	75	2	B	do.	do. Vol. II, 1863.
167	O	76	2	B	do.	do. Vol. III, 1864.
168	O	78	2	B	do.	do. Vol. I, 1877.
169	O	79	2	B	do.	do. Vol. II, Part 1, 1877.
170	O	80	2	B	do.	do. Vol. II, Part 2, 1877.
171	O	81	2	B	do.	do. Vol. I, 1862.
172	O	82	2	B	do.	do. Vol. II, 1863.
173	O	83	2	B	do.	do. Vol. III, 1864.
174	Os	175	2	D	do.	THE GAME BIRDS & WILD FOWL OF INDIA, 1864.
175	Os	176	2	D	do.	THE GAME BIRDS & WILD FOWL OF INDIA, 1884.
					Jourdain, Rev. F. C.R.	(*See* Witherby, H. F., Jourdain, Rev. F. C. R., Ticehurst, Norman F. & Tucker, Bernard, W.)
176	O	49	2	A	Kinnear, N. B., Whistler, Hugh & Ali, Sálim	ORNITHOLOGICAL SURVEY OF EASTERN GHATS, HYDERABAD, TRAVANCORE & COCHIN, bound serials, 1930–1937.
177	O	112	2	C	Kirke Swann, H.	A SYNOPSIS OF THE ACCIPITRES, (Diurnal Birds of Prey) 2nd Edition, 1922.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
178	O	13	4	F	Kirke Swann, H. & Wetmore, Alexander.	A Monograph of the Birds of Prey, Parts 1-4, Vol. I, 1930.
179	O	14	4	F	do.	A Monograph of the Birds of Prey, Parts 5-9, Vol. I, 1930.
180	O	15	4	F	do.	A Monograph of the Birds of Prey, Parts 10-12, Vol. II, 1945.
181	O	16	4	F	do.	A Monograph of the Birds of Prey, Parts 13-16, Vol. II, 1945.
182	O	206	2	E	Kirke Swann, H.	Two Ornithologists on the Lower Danube, 1925.
183	O	67	2	A	Law, Satya Churn	Pet Birds of Bengal (Song Birds), (Calcutta Oriental Series No. 10 E. 4). Vol. I, 1923.
184	O	68	2	A	do.	do. do.
185	O	207	2	F	Layard, E. L. & Sharpe, R. B.	The Birds of South Africa, thoroughly revised & augmented by Sharpe, R. B., New Edition, 1875-1884.
186	Os	172	2	D	Le Messurier, Col. A.	Game, Shore and Water Birds of India with additional references to their allied species in other parts of the world, 3rd Edition, 1888.
187	Os	173	2	D	do.	do. 4th Edition, 1904.
188	O	174	2	D	do.	do. do.
					Lester, Capt. C. D.	(*See* Palin, Hugh & Lester, Capt. C. D.)
189	O	215	2	F	Low, G. Carmichael	The Literature of the Charadriiformes, 2nd Edition, 1894-1928.
190	Os	181	2	E	Loyd, Lewis R. W.	The Protection of Birds, An Indictment, 1924.
191	O	182	2	E	do.	do. do.
192	O	144	2	D	Ludlow, Frank	Birds of the Gyantse Neighbourhood, Southern Tibet, A paper published in 3 parts in the Ibis, 1927-28.
193	O	296	2	F	Madarasz, Dr. Von Julius	Zeitschrift fur die gesammte Ornithologie, Jahrgang ii, 1885.
194	O	12	4	F	Marshall, C. H. T. & Marshall, G. F. L.	A Monograph of the Capitonidae or Scansorial Barbets 1870-71.
					Marshall, C. H. T.	(*See* Hume, Allan & Marshall, C. H. T.)
					Marshall, G. F. L.	(*See* Marshall, C. H. T. & Marshall, G. F. L.)
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196	O	214	2	F	McGregor, Richard C.	A Manual of Philippine Birds, Parts I & II, 1909.

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197	O	131	2	C	McKenny, Margaret	Birds in the Garden and How to attract them, 1939.
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					Moore, Frederick	(*See* Horsfield, Thomas & Moore, Frederick).
199	O	51	2	A	Murray, James A.	The Avifauna of British India & its Dependencies, (Vols. I & II). 1888.
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201	O	53	2	A	do.	do. Vol. II, Part I, 1890.
202	O	54	2	A	do.	do. Vol. II, Part II, 1890.
203	Os	180	2	E	do.	The Edible & Game Birds of British India with its Dependencies & Ceylon, 1889.
204	O	66	2	A	Newton, Alfred	A Dictionary of Birds, 1893-96.
205	O	232	4	E	Nicoll, M. J.	Handlist of the Birds of Egypt, Ministry of Public Works, Egypt, Zoological Service, Publication No. 29, 1919.
206	O	140	2	D	Oates, Eugene William	A Handbook to the Birds of British, Burma, including those found in the adjoining State of Karennee, Vol. I, 1883.
207	O	141	2	D	do.	do. Vol. II, 1883.
208	Os	184	2	E	do.	A Manual of the Game Birds of India, Part I—Land Birds, 1898.
209	Os	185	2	E	do.	A Manual of the Game Birds of India, Part II—Water Birds, 1899.
					do.	Nests & Eggs of Indian Birds, By Hume, Allan O., 2nd Edition, Vols. I-III, 1889-1890.
210	O	274	4	D	do.	Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History), Ratitae, Carinatae (Tinamiformes-Lariformes), Vol. I, 1901.
211	O	275	4	D	do.	Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History), Ratitae, Carinatae (Charadriformes-Strigiformes), Vol. II, 1902.
212	O	276	4	D	Oates, Eugene William assisted by Reid, Capt. Savile G.	Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History), Ratitae, Carinatae (Psittaciformes-Passeriformes), Vol. III, 1903.
213	O	277	4	D	do.	Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History), Ratitae, Carinatae (Passeriformes contd.), Vol. IV, 1908.

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216	OFR	319	7	C	do.	do. Vol. I, 1889.
217	OFR	320	7	C	do.	do. Vol. II, 1890.
218	O	263	4	D	Ogilvie-Grant, W. R.	CATALOGUE OF THE BIRDS IN THE BRITISH MUSEUM, (Game Birds), Vol. XXII, 1893.
219	O	186	2	E	do.	A HANDBOOK TO THE GAME BIRDS, Sangrouse, Partridges, Pheasants (Allen's Naturalists Library), Vol. I, 1895.
220	O	187	2	E	do.	A HANDBOOK TO THE GAME BIRDS, Pheasants (contd.), Megapodes, Curassows, Hoatzins, Bustard-Quails, Vol. II, 1897.
221	O	278	4	D	do.	CATALOGUE OF THE COLLECTION OF BIRDS' EGGS IN THE BRITISH MUSEUM (Natural History) Carinatæ (Passeriformes completed), Vol. V, 1912.
					do.	(*See* Sharpe, R. B. & Ogilvie-Grant, W. R.)
222	O	77	2	B	Oxenham, R. G.	INDEX OF ENGLISH NAMES OF BIRDS IN JERDON'S BIRDS OF INDIA, 1870.
223	O	280	4	D	Page, Wesley T.	BIRD NOTES, The Journal of the Foreign Bird Club, New Series, Vol. II, 1911.
224	O	281	4	D	do.	do. Vol. III, 1912.
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234	O	84	2	B	Peters, James Lee	CHECK-LIST OF BIRDS OF THE WORLD, Vol. I, 1931.
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					Reid, S. G.	(*See* Oates, E. W. & Reid, S. G.)
244	O	153	2	D	Roberts, Dr. Austin	The Birds of South Africa, 1940.
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262	O	279	4	D	Seth-Smith, David & Butler, Arthur G. Sharpe, R. B.	THE AVICULTURAL MAGAZINE, Vol. VI, 1908. (*See* Layard, L. E. & Sharpe, R. B.)
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276	O	269	4	D	Sharpe, R. B.	A HAND LIST OF THE GENERA & SPECIES OF BIRDS, Vol. I, 1899.
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288	O	238	4	E	do.	THE BIRDS OF BURMA, Burma Pamphlets No. 11, 1947.
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289	Os	189	2	F	Southgate, Frank & Pollard, Hugh B. C.	WILD FOWL & WADERS: Nature and Sport in the Coastlands, 1928.
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298	O	108	2	C	Ticehurst, Claud B.	A SYSTEMATIC REVIEW OF THE GENUS PHYLLOSCOPUS, British Museum (Natural History), 1938.
					Ticehurst, Norman F.	(*See* Witherby, H. F., Jourdain, Rev. F. C. R., Tucker, Bernard W. & Ticehurst, Norman F.)
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309	O	135	2	C	do.	THE AVIFAUNAL SURVEY OF CEYLON, conducted jointly by the British & Colombo Museums, 1936-39. Spolia Zeylanica, Vol. 23, Parts 3 & 4, 1944.
					do.	(*See* Kinnear, N. B., Ali, Sálim & Whistler, Hugh.)
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314	O	146	2	D	do.	A PRACTICAL HANDBOOK OF BRITISH BIRDS, Cypseli-Tubinares, Vol. II, Part I, 1924.
315	O	147	2	D	do.	A PRACTICAL HANDBOOK OF BRITISH BIRDS, Pygopodes—Galli, Vol. II, Part II, 1924.
316	O	148	2	D	do.	A CHECK-LIST OF BRITISH BIRDS, with a short account of status of each, compiled from ' A Practical Handbook of British Birds, 1924 '.

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318	O	90	2	B	do.	The Handbook of British Birds, Vol. II, Warblers to Owls.
319	O	91	2	B	do.	The Handbook of British Birds, Vol. III, Hawks to Ducks.
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321	O	93	2	B	do.	The Handbook of British Birds, Vol. V, Terns to Game-Birds.
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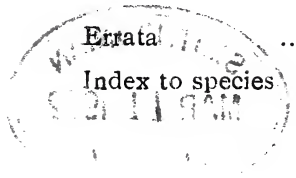

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ERRATA

Notes on Birds of the Irrigated Area of the Shwebo District, Burma, Part I—Vol. 48, No. 3.

Page 515, *Corvus macrorhynchos*. Habits. *for* solitary in pairs *read* solitary or in pairs.

„ „ *Dendrocitta vagabunda*. Status. *for* between March. and 4 August *read* between 10 March and 4 August.

Sketch-map facing p. 516. Approx. scale: *for* 13 miles to 1 inch. *read* 10 miles to 1 inch.

The channel between and parallel to the R. Mu and the railway should be named SHWEBO CANAL.

Page 518, *for Cullcicapa read Culicicapa.*

„ 523, *for Surnopastor read Sturnopastor.*

„ 529, *Cynniris asiatica*. Habits, 1.5. *for* hawking insects *read* hunting insects.

„ 531, *Hierococcyx fugax*, 1.2. *for* grass Owl *read* Grass Owl

Notes on Birds of the Irrigated Area of the Shwebo District, Burma, Part II—Vol. 48, No. 4.

Page 730, *Gyps indicus*. Habits. *for* long-billed vultures. *read* white-backed vultures.

„ 737, *Sterna aurantia*. Habits, 6th line. *for* frequently *read* several times.

„ 741, *Phalacrocorax javanicus*. Habits. *for* usually seen perched *read* usually, when perched.

„ 748, *Anas poecilorhyncha*. Habits, 6th line. *substitute* full stop *for* comma after ' 16 March 1933 '.

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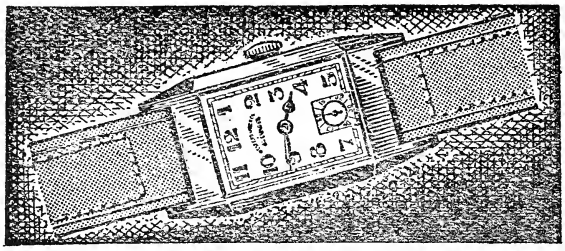

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THE MERBAL GLEN AND SOME BIRDS OF THE PIR PANJAL

BY

LIEUT.-COL. R. S. P. BATES, M.B.O.U., I.A. (Retd.)

(With a sketch map and three plates)

Karabuduran is perhaps an ugly name but this upland meadow lies at the head of the Merbal Glen, a short valley which has nothing ugly about it at all. The Merbal Glen, with the Singpur Gali near its head, a pass which leads direct to Kishtwar, has many points in its favour. Its views are not staggering, but its climate is cool and refreshing in June and July just when the Vale is stoking up. And its most convenient camp-site can, if necessary, be reached from Srinagar in one day; that is, of course, provided that a sufficiently long-suffering bus-driver can be found to risk his springs on the so-called fair weather motor road. From Achabal the trail follows the Bringh, that stream beloved of fishermen who catch in its well-stocked pools perhaps the best trout in Kashmir. At a point where the river bends abruptly northwards towards the Naubug Valley, the real test commences. Here a bone-shaking track diverges south into the Ahlan Nullah, a track which our driver—evidently very proud of his aged conveyance spouting steam from every pore—described quite seriously as 'not fit for a lorry, only fit for a car.' Seven miles upstream one's remains are deposited at a Forest Rest House. It is from near here on the west bank that the Merbal Glen takes off. This so-called glen is a short nullah, about eight miles long, running from 7,000 feet at its confluence with the Ahlan Valley to round about 13,000 feet, with the Singpur Gali crossing a col on its southern flank a couple of miles short of its head. On the Survey maps the height of this pass is given as 11,709 feet. The view from its summit is one of the most extensive I have seen and must include a considerable slice of Kishtwar. Lacking the grandeur of the usual snowy colossi of this region, its beauty lies

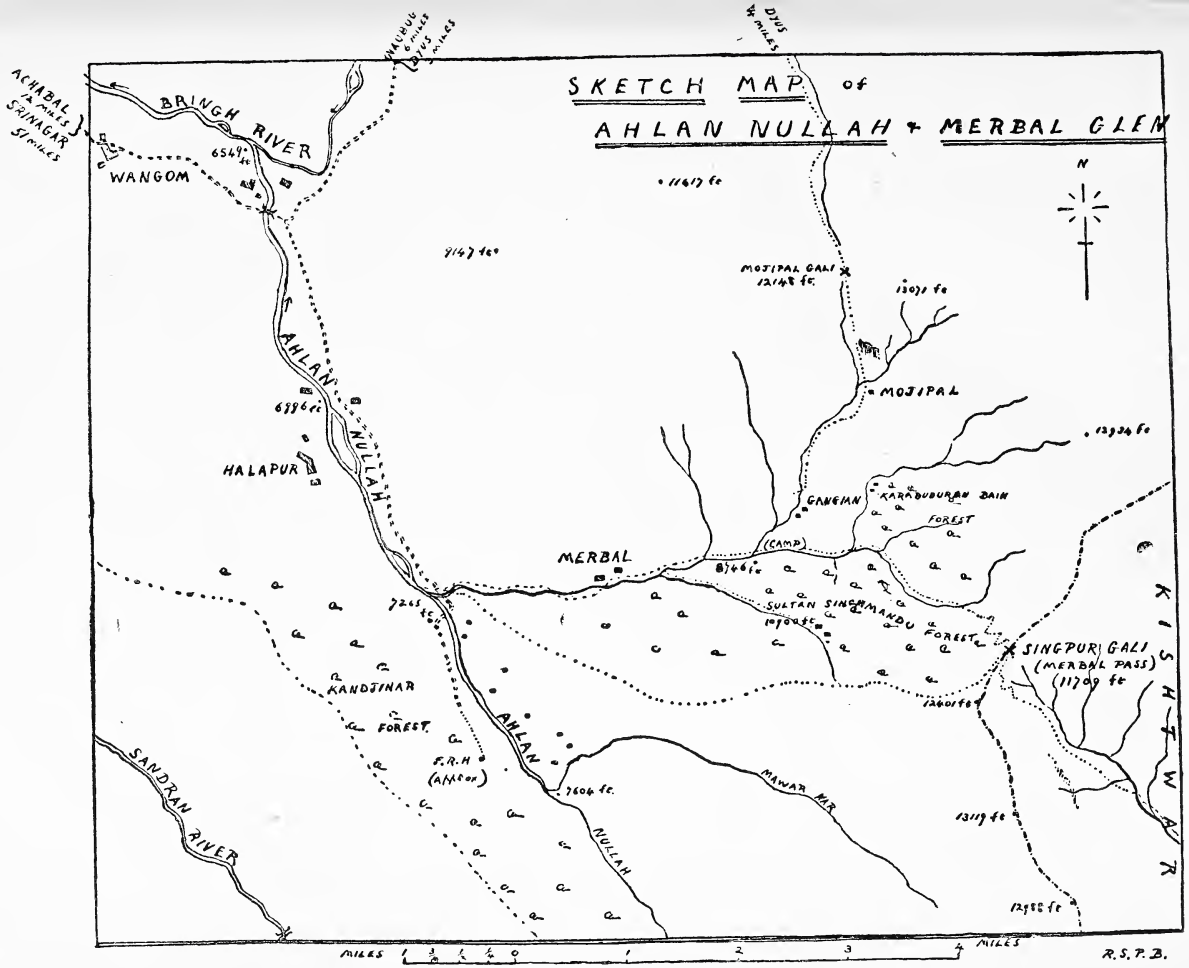
in the succession of ridge upon ridge, their spurs becoming ever bluer and more hazed as the almost straight valley, from which they radiate like ribs, recedes into the furthest distance. But the story of that summit comes later in this tale.

In June 1942 I managed to put in a month's leave and chose to visit the Merbal Glen for two reasons. In those uncertain days sudden recall had to be considered. Secondly, I felt that in that area I might have a chance of meeting with the larger of the only two laughing-thrushes which Kashmir possesses in any numbers, namely the handsome Western Variegated Laughing-Thrush, *Trochalopteron variegatum simile* Hume. The smaller rat-like Simla Streaked Laughing-Thrush is common enough in and all around the Vale at low elevations, but the Variegated is locally distributed and in the breeding season withdraws to higher altitudes. In all my summers in Kashmir I have but once come across it away from the Pir Panjal mountains, though it is said to occur sparingly on the north side of the Vale on the main Himalayan range. I have a doubtful record for the vicinity of Pahlgam, and a certainty from the slopes below the Margan Pass, but the mountains enclosing the latter must surely be included in the Pir Panjal system.

I had a further reason for choosing the Ahlan and Merbal area for this trip. I find there is little on record about the birds to be found on the Pir Panjal side of the Vale, B. B. Osmaston's list of the birds of Gulmarg being the only comprehensive account of a part of the area. In it he also includes observations as far east as Toshamaidan. The birds of the inner slopes of these mountains are not very different from those found in the valleys running into the Great Himalayan Range, but a number of migrants from India prefer to penetrate further into the system than the Pir Panjal mountains. On the other hand, some birds find the slightly warmer and certainly wetter climate more to their liking. For in climate there is indeed a subtle difference.

Ahlan F. R. H. is approximately 7,500 feet above sea level and we arrived there on June 21st. The party consisted of Mr. and Mrs. Lowther and our two selves. Bob Lowther needs no introduction to members of the Society. His beautiful photographs, which have graced the pages of the *Journal* for so long, speak for themselves. This is the sole occasion upon which we have been able to join forces and even then our leaves did not quite coincide; to our great regret the Lowthers left the Merbal Glen just before I ran the Laughing-Thrushes to earth.

Only half the rest-house being fit for occupation, my wife and I pitched our camp in the shade of some trees about 200 yards away. By 3 p.m. the temperature inside our tent ran well into the 80's. The climate struck us as considerably milder than that of Pahlgam, due presumably to the absence of snowy massifs and glaciers in the vicinity and to the restricted nature of the smaller valleys. Of birds there were plenty in variety but not in numbers, except for certain species such as the Large Crowned and Hume's Willow-Warblers. Our list soon included most, if not all, of the species noted at Pahlgam, but in lesser numbers. Dark-grey Bushchats swarmed and Willow-Warblers, as already stated, were


SKETCH MAP of
AHLAN NULLAH & MERBAL GLEN
ACHABAL
12 MILES
SRINAGAR
51 MILES
BRINGH RIVER
6549 ft
WANGOM
9147 ft
11617 ft
MOJIPAL GALI
12148 ft
13091 ft
MOJIPAL
13934 ft
AHLAN NULLAH
6996 ft
HALAPUR
GANEMN
KARADUBURAN DAIN
FOREST
(CAMP)
MERBAL
8946 ft
7265 ft
SULTAN SINGRMADU FOREST
10800 ft
SINGPURI GALI
(MERBAL PASS)
11709 ft
12601 ft
KISHTWAR
KANDJINAR
FOREST
F.R.H
(AHLAR)
7606 ft
AHLAN NULLAH
MAWAR MR
13119 ft
SANDRAN RIVER
12988 ft
MILES 1/2 0 1 2 3 4 MILES
R.S.P.B.

very numerous. Grey Tits too were common enough, and we soon had two nests to choose from, one between the boards of the rest house wall. I obtained a full, and as I thought, good series of negatives of the latter, but the enlargements from them are disappointing. These tits were feeding small young ones on grubs and caterpillars, and in most cases the grubs have obscured and apparently distorted the bill.

My next victims, on June 27th, were two Western Dark-grey Bushchats, *Rhodophila ferrea ferrea* (Gray). This pair had newly-hatched young in a nest concealed in the longer grass and clover at the edge of a small spinney. The soft waving grasses made photos at the nest well-nigh impossible, so I resorted to the well-worn but, in my view, unsatisfactory trick of providing a nearby perch. No matter how one tries to conceal the fact, such perches always manage to look out of place. On this occasion I made no attempt to conceal its nature, for the male refused to play, going round it, and under it, and fluttering over it. After I had shifted it half a dozen times, he eventually condescended to use it on his way out. His lady on the other hand took to it at once and never failed to take advanage of it at every visit.

It seemed to me that a real difference in the bird-life from that of rivers on the northern side of the Vale showed itself down by the stream. Sandpipers there were, but in small numbers, one or perhaps two pairs to the mile. The same goes for the Plumbeous Redstarts, so amazingly common on the lower and middle reaches of all the rivers from the Madmatti to the Lidar. There were a few more of them up the Merbal Glen as indeed there were of the White-capped Redstarts, but subsequently I came to the conclusion that both these species show a decided preference for streams running into the Vale from the main Himalayan range. Brown Dippers were also scarcer. The Black-eared Kite was, I think, a resident, though an uncommon one. A pair was seen wheeling overhead while we were searching for a sandpiper's nest. Lower down the valley were a few more.

Of unexpected visitors we had three. One morning a Pallas's Fishing-Eagle winged its way upstream and was shortly afterwards seen returning in the direction of the Bringh. The odd birds make forays far up the side rivers at times, but I doubt that they remain for more than a few hours before returning to the lakes, marshes, and sluggish waters of the Vale. Eastern Herons on the other hand, once their nesting is over, regularly visit the middle stretches of the side rivers up to some 7,000 or 8,000 feet, Pahlgam always having one or two throughout the summer. Nor do they confine themselves strictly to the larger waters, for I have seen the odd heron well up small tributaries running through the forests. Here we saw one only, which was standing in the shallows fishing for trout. The last visitor was a Common Myna, the only one seen at Ahlan though there were a few, probably residents, a little lower down the nullah. Later, in the first week of July, a small flock of five appeared on the Karabuduran marg at over 9,000 feet. I wonder if this virile pest is still extending its range? Late in the season eruptions of small parties to quite high altitudes are

not infrequent, though I only know them as residents in the Vale and along the Jhelum Valley road, except for a colony at Tithwal in the Kishenganga Valley.

I was itching to move into the Merbal Glen but before doing so spent a morning in the hide at a Western Spotted Forktail's (*Enicurus maculatus maculatus* Vigors) nest. This was an unwontedly open one on a rock ledge amongst the exposed roots of a tree overhanging the south bank of a side stream. Observation showed that both birds in their passage to the nest often paused on a boulder in the torrent six feet directly below it, so the hide was placed to face this rock. Unfortunately the bird which used it most, presumably the female, had a worn tail and a dejected air, traits not at all in keeping with the usual fairylike daintiness of this species. The light under the bank proved very deceptive, necessitating exposures as slow as 1/20th to 1/50th sec. with the lens stopped down to only F 5.6. I would have preferred a much smaller stop to increase the depth of focus, but the Spotted Forktails are restless birds with their long tails for ever on the move like those of the wagtail but in slower time. My photographs of this bird were below par but I'm glad to say Bob Lowther got some better results next day.

Eventually we moved off on the morning of June 30th. Logging operations were in progress somewhere on the steep hillside and sawn sleepers were being sent down the beck. The head of water appeared far too small to be made use of, but the Forest Department has its own methods for dealing with such trifling difficulties. Long runways of sleepers had been placed in a V in the stream bed. The shallow trickle in the apex of the V cunningly lubricated the runway, so that the slippery pine-logs glided gently down the slope, even taking corners in a series of slight jerks like a tram-car on its rails. Any logs sticking required but a push to start them off again. The whole runway crept slowly downstream, for logs taken from the top end as the supply ran out there, were added to the bottom. But what a tedious business it is; those sleepers must take weeks, perhaps months, to reach the wood depots around Jhelum, for even in the raging main river below Baramullah they are often held up in eddies and on islands.

At approximately 8,700 feet we came to a green lawn. A pine-covered bank sloped down to the torrent on the one hand, while a low ridge overlooked it from the north side of the track. It was not the real beginning of the Karabuduran marg, which lay a few hundred yards further on across a tumbling stream margined with kingcups and mauve lousewort, but it provided a charming and sheltered camping-ground. Indeed it proved later to be the best centre we could have chosen, not only for the Merbal Glen but for exploring three short side nullahs running off it in a northerly direction.

During that first night a rakish dead pine, whose gaunt fingers, twisted fantastically against a starlit sky, bore at intervals the silhouette of Scully's Wood Owls. Their eerie hoots brought back vivid boyhood memories of the Tawny Owls at home to which their calls, though variable, are often similar. On July 8th two

Plumbeous Redstart (male)

Photos *R. S. P. Bates*

Western Spotted Forktail

Photos

Young Kashmir Martins

R. S. P. Bates

Dark Grey Bush-chat (male)

newly fledged young ones took up their station in the same place. They kept up a monotonous wheezing all night long, broken only by an occasional crescendo of excited squeaks which usually marked the arrival of a parent.

The same evening I became aware of another noise, seemingly emanating from the servants' camp. Banteringly I asked the bearer where he had got his baby chickens. It transpired that a family of Western Himalayan Collared Pigmy Owlets—what a name for so small a bird—were in occupation of a thick fir overhanging his tent. From their mingled chirps I was unable to sort out any song pattern of adults or chicks. Osmaston describes Gulmarg birds as having a four-noted bell-like whistle. On the other hand, when on my way up to Kashmir, I had been lucky enough to catch sight of one in the Dak Bungalow compound at Domel, observing it for some minutes in the beam from my torch. It was *tonking* away as monotonously as a Coppersmith, bobbing its head from side to side at every note which gave its voice a ventriloquial effect. The calls were definitely not in series of four notes but in long sequences of more or less evenly-spaced squeaks, which I can only describe as midway between the high-pitched squeak of a bat and that of a tree-rat.

Next day, when I was looking into the fir tree to see if I could spot the owlets at roost, a family of Brook's Nuthatches trickled one after the other into an adjacent pine. The fledglings sat across a horizontal bough in the way normal to the majority of perching birds, and seemed quite averse to moving like their parents up and down the bark and on the undersides of sloping branches.

Before commencing the search for Laughing-Thrushes and other higher altitude birds, I felt I must have a morning with a pair of Plumbeous Redstarts, *Rhyacornis f. fuliginosa* (Vigors). Eventually I had to devote a second day to their photography, but it was time well spent. The nest, in a rift in a huge fallen log at the water's edge not far below our tents, was well lighted, giving me a good chance to portray the female's characteristic tail, the constant fanning of which, combined with a ceaseless up and down waving, results in a flickering effect through the periodic covering and uncovering of the increasing white on the outer rectrices by the brown terminal wedge. Is this flicker a signal to the male, a quick pointer to her whereabouts amongst the spray-covered boulders of the raging torrents, for the scintillating effect certainly catches the eye? Or is it a warning to others of the species that here is an occupied area? The Plumbeous Redstarts are intensely jealous of their territory, chasing away intruders with extreme energy quite irrespective of sex.

On my way back to camp I disturbed a Little Forktail at the junction with a small stream tumbling abruptly from the wooded slopes below Sultan Singh Mandu. This steeply falling nullah with its frequent falls and shaded rifts was typical of this forktail's habitat. A pair of Red-browed Finches was also seen, and at almost the same instant a larger secretive bird dived from a pine into some *Viburnum* scrub. This glimpse was sufficient to direct my attention to the possibility of finding the nest of the Western Variegated Laughing-Thrush within easy reach of camp. The following day,

therefore, was spent in a search along the forest edge up the left bank of the main stream to well beyond the limits of the Karabuduran marg. The undergrowth fringing the trees was composed largely of *Skimmia,* the steep bank falling thence to the bed of the stream being covered with *Viburnum* and other bushes and young firs. In spite of the seemingly favourable terrain we drew a blank, our sole find being one disused nest, an interesting nest which I am sure had been built by these thrushes. It was composed of a substantial circlet of coarse grass filled in with many sheets of papery birch bark, layer upon layer, a few of the pieces being nearly 8 inches long and 3 inches wide at their broadest. Inside this pad of bark was a thin lining of fine grass and tenuous roots. It was well concealed about three feet from the ground in one of the young firs.

Notwithstanding the poor beginning, the day ended with promise. Returning down the marg on the main track, we passed a large patch of *Viburnum* from the middle of which protruded a lonely and conspicuous sapling. From nearby there flew two laughing-thrushes. Their flight was like that of the Seven Sisters or Jungle Babblers of the plains, low to the ground with rapid wing-beats interspersed with unsteady glides. The tail was well spread showing the row of white spots at the end. In some ways, perhaps owing to the preponderance of olive-brown in the plumage, they looked not unlike very large White-cheeked Bulbuls without the crest. In the first fork of the sapling was an untidy grass nest, easily spotted at some distance as it was above the general level of the *Viburnum* scrub. Though empty it warranted further inspection. As we hunted about, the birds called loudly from the farther bank we had so lately searched, *weet-a-weer weet-a-weer,* a far-reaching and quite unmistakable cry.

By July 8th the nest held two eggs, and on the 9th when we went to erect the hiding tent on the platform of logs we had already built up, one of the birds was sitting on three eggs and continued to sit while we worked within 9 feet of her. In spite of the washed-out blue-green ground colour, the blunt eggs were rather handsome, for they were boldly blotched with rich reddish brown—Whistler, I see, calls it liver-red—and some underlying purplish spots. They were large eggs: the average measurements are given as 27.8 × 21.0 mm. Next morning I set off with great eagerness with all the bird-photographer's stock-in-trade, only to find the nest awry and no signs of eggs or birds.

It was another week before I was permitted to succeed with this species. First I tried a small nullah half a mile below camp. It took off in a northerly direction, its east flank dotted with tall trees amongst rank vegetation and patches of bushes. But the most striking features of that sharp slope were clumps of tall Kashmir Mallows in full flower and whole regiments of the withering stems of Crown Imperial lilies. What a sight that hillside must have been in May. Now the dishevelled wands were surmounted by bursting capsules, some of which had already spilled their seeds, but others rattled so invitingly that, before leaving the glen, we filled two marmalade jars with their flaky contents. In these favour-

able surroundings we saw two pairs of laughing-thrushes but could find no nest. I noticed that these birds readily ascended the isolated trees but dived for cover on our nearer approach.

I next tried the Mojipal nullah. The lower end, where there is a village of sorts, is not pleasing country, but higher up it proved to be our happiest hunting-ground and soon produced a couple of laughing-thrushes' nests which each contained two young ones. These nests were at an elevation of approximately 10,200 feet as opposed to the Karabuduran nest's 9,000 feet. Both were 4 feet from the ground in *Viburnum* scrub with no large trees in their immediate vicinity. They were 200 yards apart on opposite sides of the nullah. The owners were very secretive, and both nests were found only after diligent searching and not by watching the birds. I chose to work the one which was on level ground, the other being on a steep bank above the stream which would have necessitated facing the lens into the sun. On the 13th and 14th mornings I got the photos I so desired. The parents proved to be tame enough and soon became used to the hide. They were fairly noisy, shouting across the nullah to one another *weet-a-weer, weet-a-woo-weer,* while they also indulged in much squealing in the thick cover to the left of the hide, making subdued noises which sounded just like a nestful of quite small chicks.

During our first morning in the Mojipal nullah, a gujar informed me that a number of small birds were nesting low down on the face of a cliff near the nullah-head. While I was dealing with the laughing-thrushes, I sent my shikari, Khalik Khan, to investigate. He returned with good news. It turned out that an hour's walk away, at an elevation of about 11,000 feet, there was a small cliff with the lower part scooped out so that in wet weather by standing close to the face the rain did not reach one. Immediately I saw it, it reminded me forcibly of Kilnsey Crag in my native Dale. Here and there beneath the overhang numbers of Kashmir Martins, *Delichon urbica cashmeriensis* Gould, were busy nesting. I counted 16 nests straight off and I believe there were more. A few could actually be reached by standing on tiptoe; more could be investigated from another man's shoulders, while none was above 15 or 20 feet from the ground. But what intrigued me most was how variable they were in construction. Few of them were the neat inverted 'bee-hives' one sees under the eaves and in the window-corners of houses and barns in Britain—not more than four. The majority had been constructed ingeniously to accord with the requirements of the their sites. Those in narrow slits had the slits cemented in for some distance above and below the entrance hole. Others in water-worn cups merely had the doorways reduced in size. One or two had practically no mud-work at all, just a few straws and feathers laid within the cup. Yet again, I noted nests under a snug ledge which might easily have been taken for those of Crag Martins, had it not been for the rows of dark brown and white neat heads peeping over the rims soliciting food. At least 5 nests contained young large enough to fly at any moment, but close to the one I decided to photograph, a pair was building a new nest on the foundations of a structure which had collapsed. There were two

to three young in each nest, though I seem to recollect that one actually held four; I would not like to record this as a certainty, however. The parents spent but a fraction of a second at the nests, often transferring food into a wide-open gape without alighting at all. The arrival of a parent caused me much amusement, for it was a signal for a pair of heads to appear at every hole, the lot turning in unison as the bird flew along the cliff face. Two heads were all that the normal hole would admit at a time, though occasionally a third managed to squeeze itself into the opening.

As the direct afternoon sun could not reach my chosen nest, I hoped for a cloudless sky, and indeed the appointed day started well. Before the camera was in position, however, the sky had become overcast, and within half an hour a continuous drizzle was falling. When I left the hide, drifts of cloud obscured the summits of the pines and water dripped steadily from the cliff's overhang. It is hardly surprising that my photographs were far from successful since I had to attempt exposures of 1/20th of a second and slower with a wide stop on birds which arrived, usually without warning, to pass over their catches without pausing even to fold their wings.

Wreathing mists in the cheerless upper regions of the glen affected one with a strange feeling of isolation, but as I entered the wider space where the laughing-thrushes were skulking in the *Viburnum*, the sun came out, and I found myself taking notice of a little nature's garden by the stream. Pinky white *Morina* was pushing its way between the blue-grey stones, a neat and pleasing plant in spite of its thistle-like appearance and narrow prickly leaves. The sweet scent of the Yellow Morina makes it the more notable plant, but the coarser foliage and straggling flowers render it too untidy to compare favourably in appearance with this pink variety. A giant ragwort, with huge basal leaves well over a foot across and close-packed flowers in a tight raceme on a stem four feet high, also caused me to linger.

The pause disturbed a White-capped Redstart, *Chaimarrhornis leucocephalus* (Vigors), with its bill packed with flies for four small young in a nest under a boulder close to the stream. As it turned out, an unfortunate find this, since it caused me to spend an hour or two the next afternoon trying to depict the characteristic poise of this brilliant morsel, in particular the upright stance with wings adroop and black-tipped flame of a tail flicked vertically upright. Two exposures seemed to me to portend success, but, alas, in one the bird appears to possess no tail whatsoever, so rapidly has the flick occurred. The other, a backview which hardly does it justice, is spoilt by out-of-focus blobs in the middle distance. The time would have been better spent with the Martins again, since the day was a brilliant one.

With the exception of the Plumbeous Redstarts and the laughing-thrushes, my photographs on that expedition were far from good but in many other ways the Merbal Glen repaid us for the visit in good measure. A climb one morning to the top of the pass is more than worthy of record. One zigzags up a rather bare slope for 1,500 feet, an easy climb and one which might become boring since the views are nothing to shout about. But, after

Western Variegated Laughing-Thrush

Photos *R. S. P. Bates*

Himalayan Mistle-Thrush on nest

passing through the scattered trees not far above the stream where *Salvia hyans* was much in evidence, patches of dwarf rhododendron appeared, the flowering season now over. These, however, were backed by large bushes of *Rhododendron campanulatum* in full flower. Here and there beside the path were dainty hairbells and potentillas, while, topping the ranker grasses, were large mauve asters with narrow shaggy petals like many radiating spokes, the hub of the wheel yellow, the rim white. Though the valley below us was dank with smoky cloud, the drizzle cleared as we came to the summit of the col to disclose a view of great beauty. So far could we see through the clear washed air that the number of ridges appeared infinite, becoming a more hazy blue as they faded into a lavender distance. No snow-capped giants, no threatening cliffs of ice, but a friendly vista of tree-clad spurs radiated like ribs from the straight valley at whose very head we stood. A lark was singing to the left and a buzzard spiralled up from the Kishtwar side to sail lazily over our heads. A single Blue Rock-Thrush traversed the pass, and from far below could be heard the tapping of a woodpecker. We lazed in the shelter of a boulder eating a haversack lunch. So happy were we that we assayed the pass for a second time the very next day. It rained with unremitting zeal while we climbed through a thick fog. At the top we quaffed hot dal soup from the thermos while waiting vainly for the clouds to disperse. Our sole visitor this time was once again the Blue Rock-Thrush. In a dismal drizzle we turned for home. The narrow Karabudurun marg and its flanking pines, a couple of thousand feet below, appeared at intervals through rifts in the swirling mists. It was an eerie scene but not without beauty, and by no means a bad ending to my leave.

II

As a further article I have in mind has nothing to do with the Pir Panjal side of the Vale, I would like to add some notes relating to the Gulmarg area, since in the following year we spent a few days at Gogaldara and a week on Killenmarg. Arriving on June 3rd at Tangmarg, we crossed the Ferozpur nullah to pitch camp at the edge of some pines fringing a steep slope down to the river. The two days wait there, forced upon us by the delayed arrival from Lahore of some of our kit, was not altogether wasted, for I had dealings with three interesting birds.

The first morning, as we were breakfasting in the open doorway of the tent, a Western Collared Pigmy Owlet, *Glaucidium brodiei brodiei* Burton, snatched up a lethargic cicada almost at my feet and proceeded to devour it close by on a low branch of a pine. Standing on one foot, it conveyed the insect to its bill in the other, pulling fragments off it after the manner of a parakeet dealing with a nut. It then flew to a medium-sized chestnut tree on the fringe of the wood where it disappeared into a woodpecker's boring about 15 feet from the ground. As I peered into the hole, the owl's head slowly came up to investigate the disturbance. I could not help laughing at it. Well back in the gloom and neatly

framed in the circular opening, it looked for all the world like a wizened old man with Dundreary whiskers. It stared solemnly and sadly at me for at least half a minute and then just as slowly sank again out of sight. The hole, being that of a Pied Woodpecker, was too small to admit even my wife's hand, so I failed to ascertain the contents. We left it in peace, and had the satisfaction of sharing the half-light of our shady pines on two or three occasions before we left, for it was not altogether nocturnal, being on the move sometimes up to about 9 o'clock.

Down the hillside a pair of kestrels was extremely noisy. They had a nest, an appropriated Jungle Crow's I at first thought it to be, some 40 feet up close to the main trunk of a large pine. Twice I saw coition take place, but it was not until the morning we left, June 6th, that the first egg was deposited. On our way back from Killenmarg to Srinagar on the 20th, I made a point of slipping across the nullah to see how these birds were faring. Confusion reigned. They appeared to be at loggerheads with a sparrow-hawk, which twice approached the nest while I was standing at the foot of the tree. I considered this behaviour sufficiently strange, but when I saw the nest's contents my curiosity was vastly increased. There were now three eggs, two of them the dull mottled red of the kestrel's showing little or no ground colour. The third had a flat blue-white ground and some large blotches of a somewhat richer red-brown scattered chiefly at the smaller end, if smaller end it can be termed, for in truth there was little to choose between either extremity. This egg, in fact, agreed with many sparrow-hawk's eggs I have seen, but with no kestrel's egg it has ever been my lot to examine. After photographing the eggs in the nest, which, incidentally, was made almost entirely of sticks, finer ones in the cup, I removed them. As I suspected, those of the kestrel type were none too easy to blow, having been incubated for some 12 to 14 days, but the third egg was absolutely fresh. Could this egg have been laid by the sparrow-hawk I encountered that morning? Is it not possible that the nest was used originally by the sparrow-hawks, who, having turned up to reclaim it were now engaged in battle with the kestrels, a battle which they appeared to be winning! It is impossible to say with certainty that such is the case, but I give this solution for what it is worth. A point which perhaps militates against it, is that I see Stuart Baker states in the *Nidification* that the sparrow-hawk does not normally use a nest for more than the one season. Subsequently I sent the eggs to the Prince of Wales's Museum, Bombay, where no doubt any member who wishes to see them can run them to earth.

Prior to leaving the Ferozpur nullah for Gogaldara, I spent a couple of hours in the hide photographing a Simla Black Tit, *Lophophanes r. rufonuchalis* Blyth. As usual its nest, containing young ones, was in a hole in the ground. This ran horizontally into a grassy bank. I have at times found them in tunnels, often amongst tree roots, entering the ground at so steep an angle that the bird literally fell in head first from some overhanging twig or foliage. I know the *Nidification* has it that holes in and near the ground are the exception rather than the rule, but I am convinced

that at least in Kashmir the position is actually the reverse of this. The majority of nests are in holes, often rat-holes, in grassy banks, under the roots of trees, and sometimes in walls. I once saw a bird disappear down a small hole in the very middle of a well-used path made up of hard-trodden earth from which all vegetation had been worn away. It was taking moss down to a cavity some inches below the surface. Perhaps it liked the sound of tramping feet! It is the Crested Black Tit, *Lophophanes melanolophus* Vigors, slightly smaller and with an inconspicuous row of spots on the wing, which patronizes the tree sites between say three and 20 feet. But to revert to my Ferozpur bird. Just as I was warming to the task, after one of the birds had arrived with a Large White butterfly in its bill, an unusual occurrence to say the least of it, a troupe of Rhesus monkeys reached the vicinity and made such nuisances of themselves that I had to leave the hide.

I'm afraid that I did not find the Pir Panjal forests around Gogaldara particularly birdy; in fact they were disappointing in comparison with those on the north side of the Vale, but all the same I was struck by the comparatively large numbers of hobbies. During the few days we occupied the F.R.H. there, June 6th to 14th, I marked down three pairs of these little falcons which appeared already to have commenced nesting. All had their nests high up in pines, not in isolated ones, but in localities where the trees were dotted about in clumps which could hardly be described as true forest. I have seen them in the same type of country on the other side of the Vale; for example, in the Erin nullah and at Aru in the Lidar Valley. They also nest within the fringes of the heavier woods. I could only reach one of these nests. It was still empty, even when we left, but that did not save me from being repeatedly dive-bombed on the 7th while I was climbing up to it. In Kashmir the hobbies appear to lay a little later than the other falcons; usually round about the end of June and in July.

The Gogaldara Rest-house, and a barn close by, had been patronized by a pair of Himalayan Whistling-Thrushes. There were two compact but old nests under the gable ends of the former, while a newer one was on a tie-beam inside the out-house. As I came out through the barn door, I almost collided with a young turtle-dove which swerved in to escape a pursuing Jungle Crow, for the terrified fledgling was still weak on the wing. I considered it best to shut it up inside for a spell. When I returned, an hour or so later that villainous crow was still on guard. As I opened the door, the dove flew from underneath the hut—it had found a way through some broken floor boards. The crow overhauled it within a hundred yards, forced it down behind some bushes, and as I panted to its rescue, cruelly beheaded the poor thing before my very eyes, and flew off with its ill-gotten prize, leaving the warm gorey body twitching on the ground. Jungle Crows are appallingly destructive of eggs and young, but I had not previously seen one pursue an active fledgling with such persistence.

On June 7th I found a Mistle-Thrush's nest containing 3 fresh eggs, the clutch being completed to 4 the following day. It was built near the end of a drooping fir branch not very well screened

and only 7 feet from the ground. It was overhanging the edge of a path leading through the forest from some cultivation lower down the hill-side. I watched the bird sitting quite peacefully as a couple of men walked underneath the nest, utterly unconscious of her presence. A few days later I roped the branch to one a little higher up, as a man with a tall load bumped an egg to the ground. The wood here was of open character with some deciduous trees in it as well as the pines. Mistle-Thrushes were well distributed over these hill-sides, for their loud song, which carries well from the higher tree summits which they invariably choose for singing-posts, was borne to us every morning from most points of the compass. I found one other new, but as yet empty, nest in an almost identical situation. Their nests are at times seen close to the tree-trunks, and occasionally in the forks of small saplings, but I think this drooping-branch site is a highly favoured one. Both these nests were typical, a copious grass lining over a certain amount of clay, the outer parts consisting of coarse twigs well covered with lichen and mosses.

I had no difficulty whatsoever in getting the Mistle-Thrush's photograph. She wanted to return to the nest long before I was ready for her, and indeed did so. Perhaps this was why I made the mistake of completing the erection of the tent and —I must confess it—its quite unnecessary camouflaging, before ascertaining the best distance at which to place the camera. I found I was too close for comfort, the depth of focus being too narrow and the field too restricted. Using the small plates ($3\frac{1}{2}'' \times 2\frac{1}{2}''$) insufficient surroundings to the nest were shown, and I had to content myself with well-stopped-down portraits of her Ladyship incubating. As she insisted on getting well down into the cup, I was unable to show to advantage the bold spotting of the underparts. It is most important first to get the camera correctly positioned and then to build up the hide around it.

Tickell's Willow-Warbler is the last bird about which I wish to write. We encountered it, of course, after moving up to Killenmarg. Where the slopes steepen beyond the skiing hut, where dwarf rhododendrons and the large *Rhododendron campanulatum* with delicately tinted mauve and pale blue flowers, make their appearance, this little bird became evident. It was here, on the morning of June, 16th, at a little above 11,000 feet, that I saw a Tickell's Willow-Warbler, *Phylloscopus affinis* (Tickell), with a short length of grass in its bill. Which of the two untidy beginnings, 18 inches from the ground in a small patch of juniper, was to become the finished article, I could not say, nor did the bird seem to have quite made up its mind. After tea we went up again, taking the hide with us. There was then no doubt about their plans. These minute warblers, choosing to nest from 11,000 feet up to the permanent snowline, have of necessity to crowd their nesting into a short space of time. We found them feverishly at work on a structure which was already taking shape. So intent were they on their important work that I believe the tent was quite unnecessary; a simple screen would have sufficed, for, except when I was kneeling directly between the tent and the nest with my feet close to the fast-growing untidy

ball, their visits never ceased. Both birds were hard at it, finding all the material they required around the immediate bush in which they were building.

I was in the hide next morning soon after 7 a.m. They were building in furious bursts lasting about quarter of an hour, still finding their lengths of dry grass within a small radius from the nest. This was quite conspicuous—it often is—being wedged into the dark outer foliage of a low juniper bush with which the almost white straws contrasted strongly. It looked to me as if they would soon start bringing the feathers with which they so thickly line the envelope for protection against the bitter nights. I was a little too soon for that. At the end of each burst they flew 50 yards or so down the hill-side to feed quietly for a few minutes before resuming operations. Altogether I used 16 plates on them, varying the exposure and stop between F8 and 1/200th and F16 and 1/40th. The light even in the early morning was very strong. I was able to tell the birds apart by the way in which one of them jumped at each clap of the shutter, raising its wings slightly as it did so. But whether the nervous one was the male or the female I cannot say. I suspect it was the male for its visits were the less frequent of the two and the female is generally the bolder at the nest. For the fast exposures I was perforce using the focal plane shutter, but, even when employing the silent *Luc* shutter, I had few failures, only three of the negatives showing movement.

Shortly before 10 o'clock I packed up. Variegated Laughing-Thrushes were calling in some tall bushes on the edge of the marg, and somewhere beyond a stony ridge a Central Asian Blackbird was nest-building, repeatedly flying over my head with quantities of material in its bill. Unfortunately I failed to locate the site for it became very cautious as soon as I entered its territory.

THE INDIAN CADDIS FLIES (*TRICHOPTERA*)

BY

THE LATE MARTIN E. MOSELY

(*Dept. of Entomology, British Museum, Nat. Hist.*)

PART X

(*With 12 plates*)

(*Continued from page 245 of this volume*)

SERICOSTOMATIDAE McLACHLAN (*continued*)

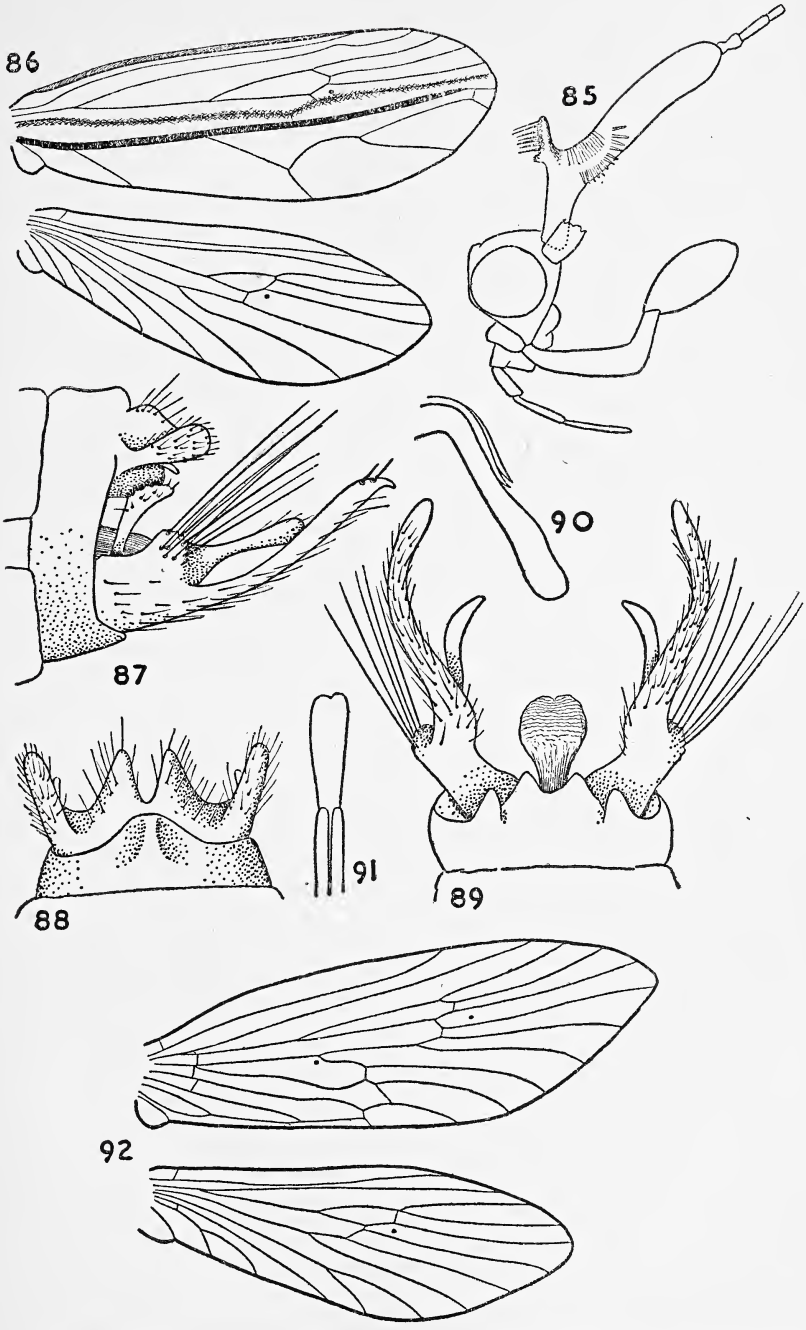
Anacrunoecia gen. n.

Spurs, 2, 4, 4. In the ♂, the basal joint of the antenna armed with a furcate process at its base. In some species there is an additional small branch placed very close to the main furcate process; no process towards the middle of the joint. Maxillary palpi two-jointed, varying in shape in the species. Wings clothed with hairs and scales; post-costal fold very long, situated towards the centre of the wing, with three large cellules between it and the lower margin, (four in *A. assamensis*). Inferior appendages generally furcate at the apices, with an erect branch at the base.

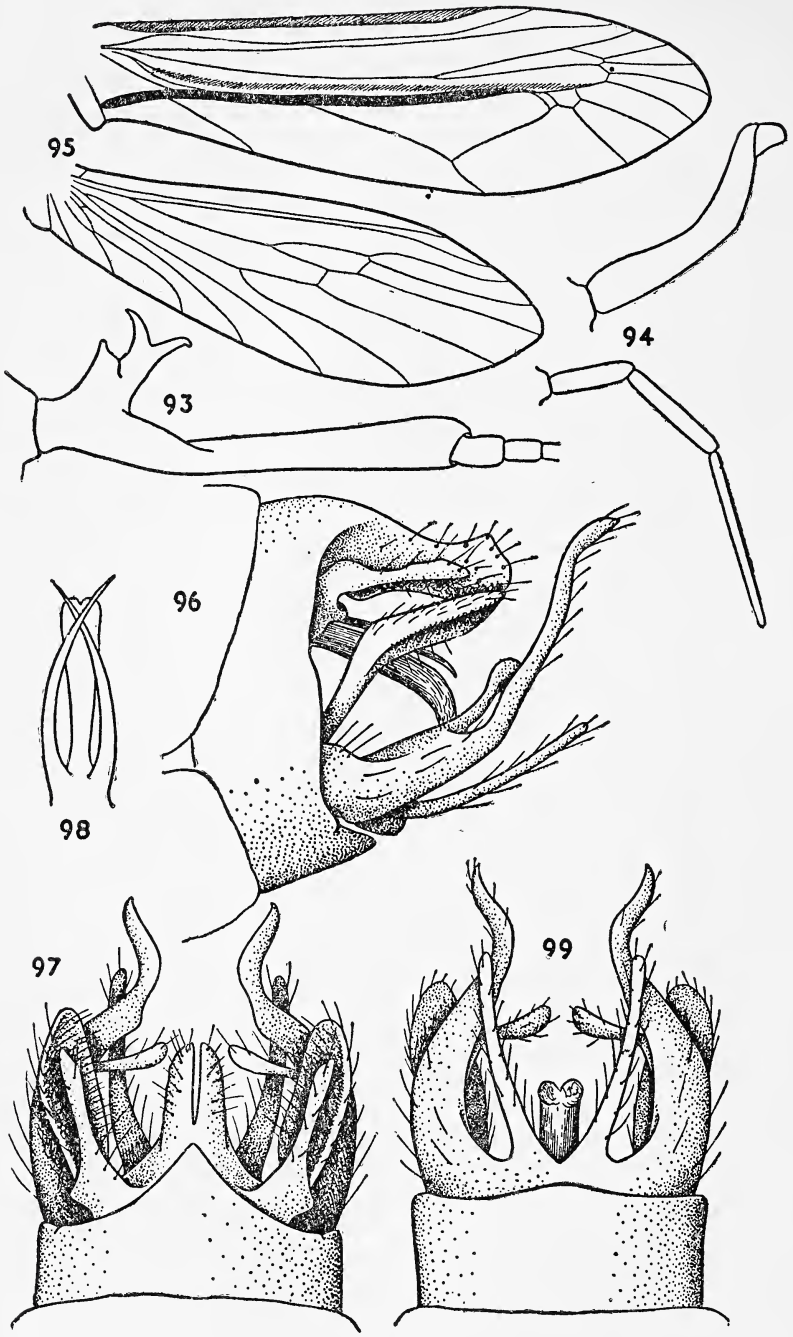
Genotype,—*A. atania* sp. n.

Anacrunoecia assamensis sp. n. Figs. 85-92.

Insect warm chestnut brown; description of the ♂; basal joint of the antenna not very long, a single branch towards the base, its margin fringed with long, peg-like spines or teeth; this branch carries a subsidiary branch or wart on its inner basal margin; above the branch, the basal joint is somewhat hollowed out, the surface of this hollowed portion being set with transverse ridges; maxillary palpi membranous and two-jointed, basal joint elbowed, terminal joint broad, much dilated; wings clothed with hairs, and with a few scales at the basal end of the central groove, none on the posterior wing; costal margin of the anterior wing with the extreme edge folded over; discoidal cell rather long, a groove through the middle of the wing nearly to the apex, a fold just beneath it; four cellules along the posterior margin, of which the second from the base is the largest; in the posterior wing, the base of the fourth apical cellule extends further inwards than the base of the discoidal cell; in the ♀, fork no. 5 present in the posterior wing. Genitalia ♂.—Ninth dorsal segment produced at its centre in a broad triangle beyond which is a dorsal plate, produced at its centre and excised to make a pair of large angular projections; the outer angles of the plate are produced in finger-like processes directed tailward and separated from the central triangles by rounded excisions; each of these processes bears a small finger



Figs. 85–92. *Anacrunoecia assamensis* sp.n. 85, ♂ head from side. 86, ♂ wings. 87, ♂ genitalia, lateral. 88, ♂ ninth segment and dorsal plate, dorsal. 89, ♂ ninth segment, inferior appendages and penis, ventral. 90, penis and sheaths, lateral. 91, penis and sheaths, dorsal. 92, ♀ wings.



Figs. 93-99. *Anarunoecia atania* sp.n. ♂. 93, base of antenna, inner surface. 94, maxillary and labial palpi, lateral. 95, wings. 96, genitalia, lateral. 97, genitalia, dorsal. 98, penis and sheaths, dorsal. 99, genitalia, ventral, dorsal plate omitted.

directed downward on its under surface; penis straight, from above and beneath, with a narrow stem and dilated apex; sheaths short and symmetrical, lying side by side over the base of the stem, inferior appendages single-jointed, branched, the main stem short and stout with the lower angle produced in a long, slightly upcurving, fringed finger with an acute apex; this finger is rather more than twice the length of the base, of which the outer angle is slightly produced and rounded; on the inner side of this rounded angle arises another long branch, which is constricted in the middle, gradually expanding to a rounded apex, from beneath, caliper-shaped; this branch is rather more than half the length of the fringed finger; a third and rather shorter branch arises from within the upper margin of the appendage at its base and is directed upward, gradually dilating to a roughly truncate apex; ventral margin of ninth segment produced at its centre, leaving two pairs of triangular processes.

Length of anterior wing ♂ 9 mm.
Length of anterior wing ♀ 10 mm.
Length of basal joint of ♂ antenna 1.75 mm.

Assam: Cherrapunji.

Type ♂ and paratypes ♂ ♀ in the collection of the British Museum (N.H.)

Anacruncecia atania sp. n. Figs. 93-99.

Insect brown in colour; basal joint of the antenna in the ♂, long and broad from the side; at its base, on the upper surface, is a stout, inturned, trifurcate claw, fringed with the usual spine-like hairs and with the centre fork the longest; maxillary palpi two-jointed, basal joint long and curved, terminal joint very small; labial palpi, terminal joint very long and slender, about twice the length of the second, which is half as long again as the first; a spur on the posterior leg unusually thickened; wings clothed with hairs and scales, the latter mainly confined to the nervures, all forks and cellules sessile; anterior with a deep costal fringe attached to a narrow edge of the costa, which is turned over along the subcosta; a median groove and a post-costal fold very close beneath it; four cellules along the posterior border, of which the second from the base is the largest and the third is triangular and is connected to the border of the wing by a nervure; neuration very aberrant; posterior wing with a normal neuration, fourth apical cellule extending only slightly further inwards than the basal angle of the discoidal cell.

Genitalia ♂.—Ninth tergite produced in a wide triangle; beyond it is a large dorsal plate bearing two pairs of processes, the middle pair long and rather broad and separated by a narrow excision; the outer, slender, constricted at the middle and dilated at the apices; from the side, the base of this process is roundly excised with a small knob on the lower margin; penis short, directed downward with two spine-like sheaths crossing each other above it; inferior appendages single-jointed, four-branched; the upper branch broad and spatulate, directed upward and then slightly distally and situated at the base of the appendage towards its

upper margin; the second and third branches arising from a stout base, the lower very long and sinuous, about twice the length of the upper, which is directed inwards with a clavate apex; another long and slender branch arises from each lower margin at the inner basal angle as seen from beneath.

Length of the anterior wing ♂ 9.5 mm.

Length of the basal joint of ♂ antenna 1.61 mm.

N.-E. Burma: Kamjan, 12. vii. 1934, 6,300 ft. R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes in the Stockholm and the British Museum collections.

Anacruncecia digitata sp. n. Figs. 100-105.

Insect brown. In the ♂, wings covered with hairs and scales; anterior with the costa narrowly folded for almost its entire length; post-costal fold situated nearly as far up as the centre of the wing, long, extending practically to the apex, fringed with a very dense row of thickened hairs; in the post-costal area are three large cells, the upper triangular, the other two of about the same area; discoidal cell long and narrow; all the apical cellules very long and narrow, except the third which is long but broadened at its base; posterior wing with the neuration regular. Basal joint of the antenna about as long as the width of the head with the oculi, very stout, with a strong branch at its base, apex furcate, small irregular processes situated on the inner surface of the joint; the lower margin at the base, deeply indented. Maxillary palpi two-jointed, basal joint stout, terminal about the same length but more slender and covered with a furry vestiture; labial palpi with a long terminal joint.

Genitalia ♂.—The apical margin of the ninth tergite is produced in three long processes of which the central is excised nearly to its base, leaving a pair of long, slender fingers, sparsely clothed with bristles; from the side, the lateral processes are very deep, the central fingers projecting beyond them; penis short, apparently without sheaths; inferior appendages with a single short branch, only visible from the side, arising at the base from the upper surface and directed upward; apex of the appendage produced in what may be a second joint or the vestige of one, welded to the basal joint; lower surface very heavily clothed with thickened hairs.

Length of the anterior wing ♂ 11 mm.

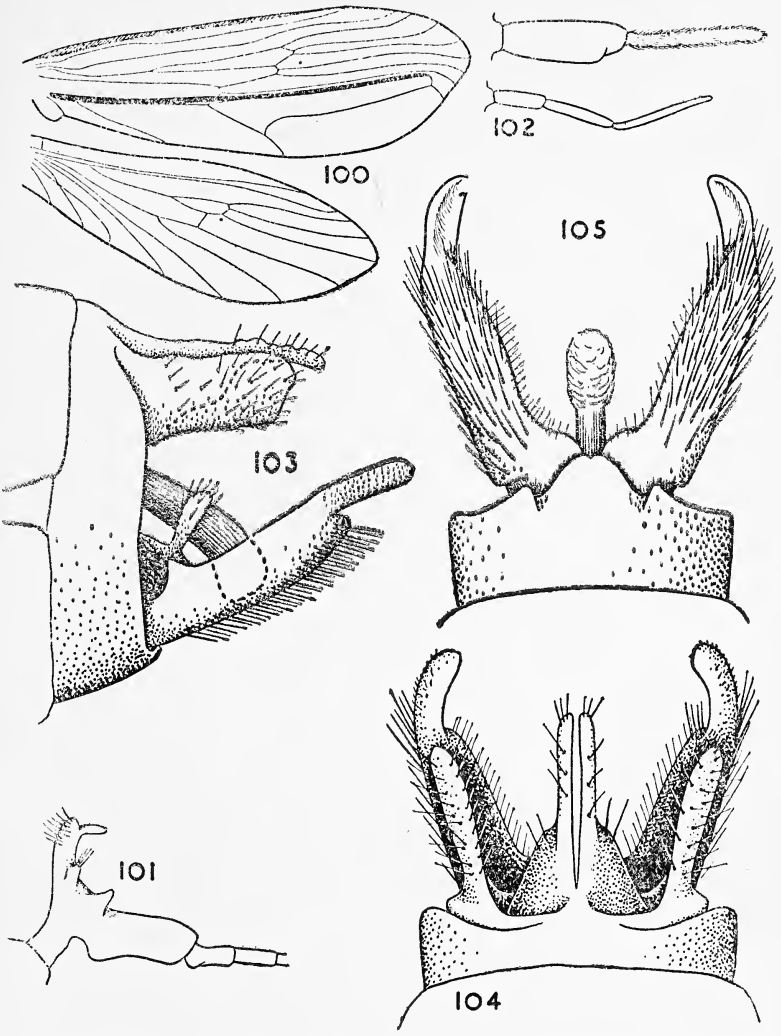
Length of the basal joint of the antenna 1 mm.

Assam: Khasi Hills, from the McLachlan collection.

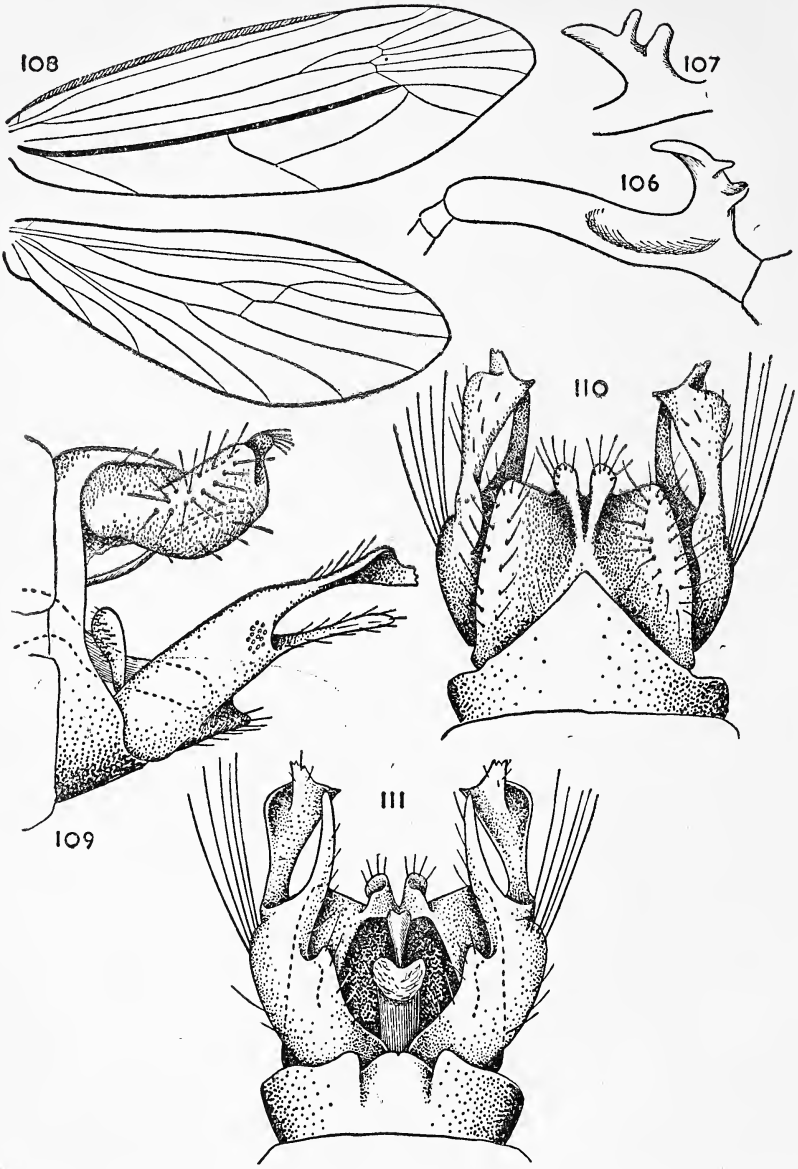
Type and paratype ♂ in the collection of the British Museum.

Anacruncecia timbaka sp. n. Figs. 106-111.

Insect brown. In the ♂, antennae with the basal joint short, very stout, with a stout, hooked process at its base, on which is seated a pair of short bars, parallel with each other; maxillary palpi densely clothed with hairs, difficult to make out, probably with two broad joints; wings covered with hairs and small, whitish scales; post-costal fold very conspicuous, fringed with long hairs



Figs. 100–105. *Anacrunoecia digitata* sp.n. ♂. 100, wings. 101, base of antenna, inner surface. 102, maxillary and labial palpi, lateral. 103, genitalia, lateral. 104, genitalia, dorsal, penis omitted. 105, genitalia, ventral, dorsal plate omitted.



Figs. 106–111. *Anacrunoecia timbaka* sp.n. ♂. 106, base of antenna, inner surface. 107, process at base of antenna from another aspect. 108, wings. 109, genitalia, lateral. 110, genitalia, dorsal. 111, genitalia, ventral.

and extending considerably more than half-way along the wing, three large cellules between it and the posterior border.

Genitalia ♂.—Apical margin of the ninth tergite much produced; dorsal plate broad, centre forming a raised V-shaped process; immediately beneath the centre of the plate is a slender-stemmed process, possibly an upper penis-cover with a dilated and excised apex; no apparent penis-sheaths; penis short and sinuous; inferior appendages branched and single-jointed, a branch with a dilated apex arising from the upper margin near the base and partially concealed within the segment; apex bifurcate, upper fork, from above and from the side, with a much dilated apex of complicated shape; lower fork slender, slightly shorter than the upper; from beneath, there are angular projections of the lower margin of the appendages about midway; ventral margin of the ninth sternite sinuous and excised.

Length of the anterior wing ♂ 9 mm.

Length of the basal joint of the antenna 1.8 mm.

N.-E. Burma: Kambaiti, 4-8. vi. 1934, R. Malaise.

Burma: Ruby Mines, 5,500-7,000 ft., 1890.

Type ♂ (Kambaiti) in the Stockholm Museum, paratype ♂ (Ruby Mines) in the British Museum collection.

Dinarthrella Ulmer.

Dinarthrella Ulm., Genera Insect., fasc. 60a, p. 108, 1907.

Spurs, 2, 4, 4. In the ♂, basal joint of the antennae long, armed with a single and simple branch, sometimes rudimentary, situated at its base. Maxillary palpi two-jointed, basal joint stout and curved, terminal joint very small. Martynov's figure of *D. betteni* shows only one joint curved up in front of the face. Wings clothed with hairs and scales; in the anterior there is a fold but scarcely in the post-costal region. It passes through the centre of the wing so that it is completely separated from the lower marginal cellules which form a parallel and diminishing series from the base to the apex. Inferior appendage branched at its apex, the branch arising at the base is directed distally rather than upwards.

Genotype.—*D. destructa* Ulm.

Dinarthrella betteni Martynov. Figs. 112-116.

Dinarthrella betteni Mart., Rec. Ind. Mus., 38, pp. 286-288, figs. 57-59 a-c, 1936.

'1 ♂. Eastern Himalayas, Pashok, Darjeeling district, 3,500 ft., 1-12. x. 17, F. H. Gravely (in spirit).'

'The specimen is young and pale; colouring in fully adult specimens would be darker.'

'Head pale, clothed with dense pale, greyish-yellow hairs, with some admixture of brownish ones near the eyes. Basal joint of the antennae as long as the thorax, slender, sinuate from the side, pale, densely clothed above and beneath with dense, slender, erect, rufous brownish hairs; on the distal portion the hairs become paler, yellowish-grey; basal portion of the joint ending in a short triangular process or projection; thread pale yellow.'

'Maxillary palpi long, pale, adjacent to the head, curved upwards, their ends are situated between the bases of antennae and bear here a dense tuft of brownish-yellow hairs. Labial palpi long; 3rd joint longer than 2nd, which in its turn is longer than first. Thorax yellow, mesonotum elongated, twice longer than the metanotum, brownish, with two rounded pale marks bearing tufts of pale erect hairs; behind them two more small whitish spots. Metanotum brownish. Legs pale yellowish. Anterior wings pale, narrow; costa thick; subcosta running near to it, in its basal part apparently uniting with it with dense series of yellowish hairs turned backwards; this series is continuous with the hairs arising from costa. R straight, thick; RS originating early from it and forming a narrow and short discoidal cell, concealed by hairs, starting from M and therefore not easily distinguished. Only the basal part of M may be discerned, since its further part is concealed by a long and distinct anal fold, extending from the base up to the end of M_1; from the base of M and from the fold arise forwards dense series of brownish-grey hairs as in *Dinarthrella destructa* Ulm. Venation behind this fold is much disturbed as in *D. destructa*; three branches of M, CuA_1, CuA_2 and CuP connected basally and forming series of parallel (except CuP) veins; in the proximal part of wing there is only A_1, which is oblique, straight; jugal lobe rounded. Venation in posterior wings similiar to that in *Dinarthrella* sp. Betten, 1909.'

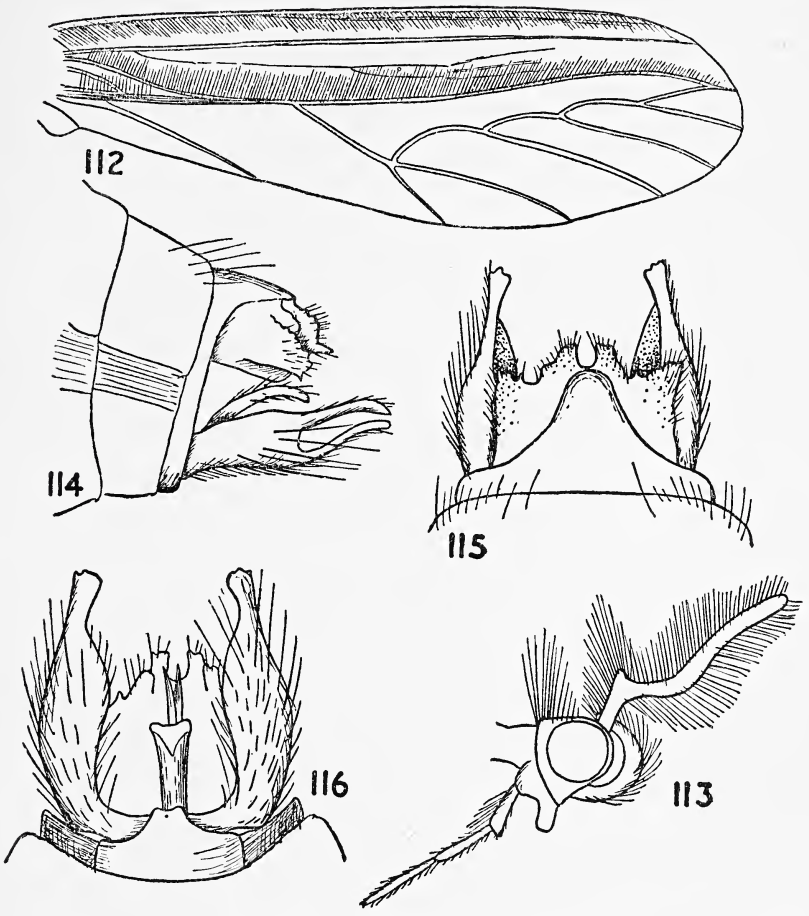
'Abdomen pale brownish, tergites provided with dark transverse (slender) thickenings at their anterior edges; 1st tergite broad, brownish.'

'♂. Side pieces of 9th segment with straight hind edges; sternite narrow with a small median projection; tergite forming a broad projection narrowed behind and reaching the base of the median excision of 10th segment, broad both from above and from the side; one may distinguish here, as in *Dinarthrum*, one median and two lateral portions; side portions short, irregular, hairy, separated from the median by two broad excisions, in which two more minute processes may be seen. Median portion also short, but with a rounded excision divided into two irregular projections, broad from side, narrower from above.'

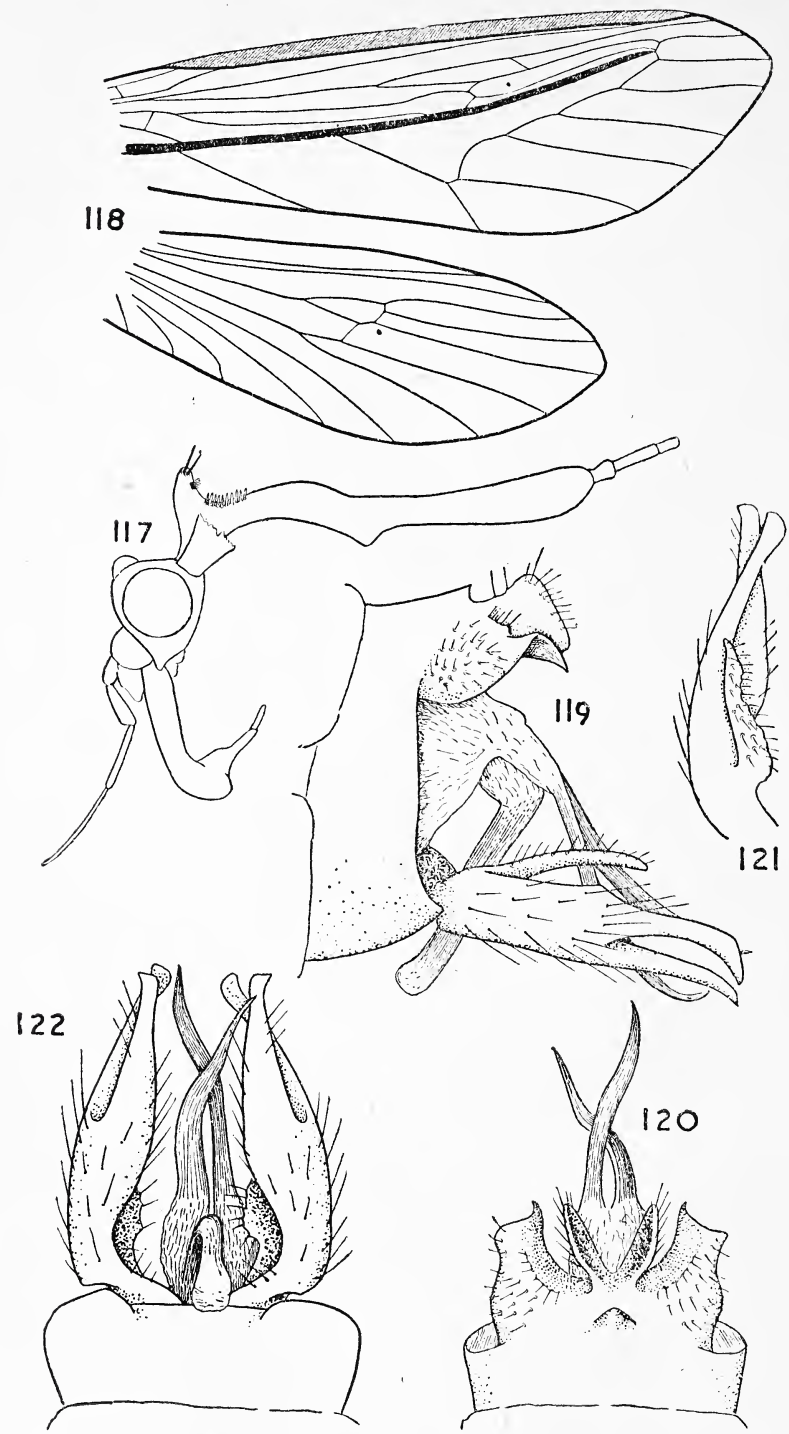
'Pedes genitales broad from the side, hairy, divided near the middle into two branches, upper and lower, the lower being more slender and bearing beneath dense greyish brown hairs; seen from beneath the pedes genitales are dilated in the middle, then attenuated (lower branch); apices ending in two or three tubercles. From the bases of the pedes genitales arise two pale sabre-shaped processes, reaching the base of the upper branch. Penis short; above it two titillators, acute at ends.'

'Length of body 6 mm.'

'*Remarks.—Dinarthrella* sp. briefly described and figured by C. Betten (Rec. Ind. Mus., 3, p. 241, pl. 18, figs. 10-12, 1909) belongs probably to this species, although there is some difference in the shape of the basal joint of antennae and in the venation of the fore wings. DC and its branches are almost invisible in our specimen, but it is young, Rs and M are here very pale and weak



Figs. 112–116. *Dinarthrella betteni* Mart. ♂. 112, anterior wing. 113, head from side. 114, genitalia, lateral. 115, genitalia, dorsal. 116, genitalia, ventral. (All after Martynov).



Figs. 117–122. *Dinarthrella destructa* (Ulmer). ♂. 117, head from side. 118, wings. 119, genitalia, lateral. 120, ninth segment, dorsal plate and penis sheaths, dorsal. 121, inferior appendage, dorsal. 122, genitalia, ventral.

and therefore indistinct; Betten's figure of the basal joint of antennae is perhaps not quite correct (Betten's specimen was in bad condition). *Dinarthrella betteni* Mart. is evidently allied to *D. destructa* Ulm. from Darjeeling, but distinct.'

Dinarthrella destructa Ulmer. Figs. 117-122.

Maniconeura destructa Ulm., Notes Leyd. Mus., XXVIII, pp. 28-29, figs. 35-36, 1906.

Dinarthrella destructa Ulm., Gen. Insect., fasc. 60a, p. 108, pl. 15, fig. 130, 1907.

The type, in the Paris Museum, is in very poor condition and it was necessary to pass the head and abdomen through caustic potash before an examination could be made. One pair of wings was removed and denuded for the purpose of this re-description and this procedure no doubt accounts for any discrepancies between the figures here given and those of Dr. Ulmer, made from the undenuded wing.

Insect brownish. Description of the ♂; basal joint of the antenna long, slightly elbowed midway, without any processes but with a strong angular projection at the base carrying three or four long spines; there is a second but smaller angular projection at the point where the joint is elbowed; maxillary palpi membranous, with a long basal joint sharply bent and somewhat dilated rather beyond midway; beyond the bend, the joint is constricted, making a slender terminal portion followed by a very small second joint; wings, anterior with a narrow rim at the costa bent over onto the subcosta; the anterior part of the wing is clothed with scales and hairs; through the centre of the wing there is a heavy fringed fold, somewhat of a different character to folds in other species of the *Lepidostomatinae* and approaching the formation of a groove; beneath the fold, the neuration is very abnormal and the vestiture is confined to hairs with no apparent scales; posterior wing with normal neuration; fourth apical cellule extending not quite so far inward as the basal angle of the discoidal cell.

Genitalia ♂.—Ninth dorsal segment produced in a triangular prominence, beneath which is a broad dorsal plate bearing two broad outer wings, with sinuous outer margins as seen from above, and truncate apices, of which the inner apical angles are slightly produced; from the side these angles appear as triangular processes with acute apices directed downward; between the outer wings is a pair of diverging plates set on edge, from the side shaped like a blunt foot, toes directed downward, the sole of the foot forming an obliquely truncate apex; penis short, directed downward with a pair of long, sinuous, asymmetrically-twisted sheaths; inferior appendages single-jointed but three-branched, from the side, with a stout base terminating in two branches somewhat resembling a lobster's rather slender claw; the third branch, which from above has a dilated and serrated inner margin, is seen, from the side, to arise from the upper margin of the appendage towards the base.

Length of anterior wing ♂ about 9 mm.

Length of basal joint of the ♂ antenna 2.8 mm.

Darjeeling: Harmand, 1890.

Type ♂ in the collection of the Paris Museum.

I am much indebted to Dr. L. Berland, of the Paris Museum, who kindly allowed me to make preparations of the various parts of the type for the purpose of this description.

An example from N. E. Burma, Kambaiti, 6,800 ft., 8. iv. 1934, R. Malaise, belongs here.

Ulmerodes gen. nov.

Dinarthrodes Mosely nec Ulmer, *J., Bombay Nat. His. Soc.*, 41, p. 334, 1939.

Spurs 2, 4, 4. In the male, the basal joint of the antenna armed with two processes, one at the base, the other towards the middle. Maxillary palpi two-jointed, basal joint generally curved, terminal long and slender. Wings clothed with hairs and scales; in anterior wing, discoidal cell long and narrow; post-costal fold about half the length of the wing, sometimes less. Penis sheaths present. Inferior appendages trifurcate at the apices, with an upright branch arising at the base.

Genotype.—*Dinarthrum armatum* Ulmer.

Ulmerodes armata (Ulmer) Figs. 123-128.

Dinarthrum armatum Ulmer, Ann. Naturh. Mus. Wien, 20, p. 69, figs. 28-30, 1905.

Dinarthrodes armata Ulmer, Gen. Insect. fasc. 60a, p. 106, 1907.

Insect brownish. In the ♂, wings clothed with hairs and scales; post-costal fold short, less than half the length of the wing; only two cellules between it and the posterior margin, the distal the longer; basal joint of the antenna long with two processes, the longer at the base, the shorter about midway; maxillary palpi two-jointed, first joint with a sharp elbow, second slender, longer than the first.

Genitalia ♂.—Dorsal plate produced in three slender processes of about the same length, one at each angle and the third at the centre; the lateral are set at a lower level than the central process and, seen from the side, have sharply elbowed bends towards their bases; the central process arises from a wide base whose lateral margins are produced downward in deep keels; penis short and curved; sheaths straight, parallel, with very acute apices; inferior appendages branched, a short, upright branch on the upper margin at the base; apex of the appendage trifurcate, the upper fork short, curved and slender, the lower pair of about the same length, lying parallel, the lower, from the side, the stouter.

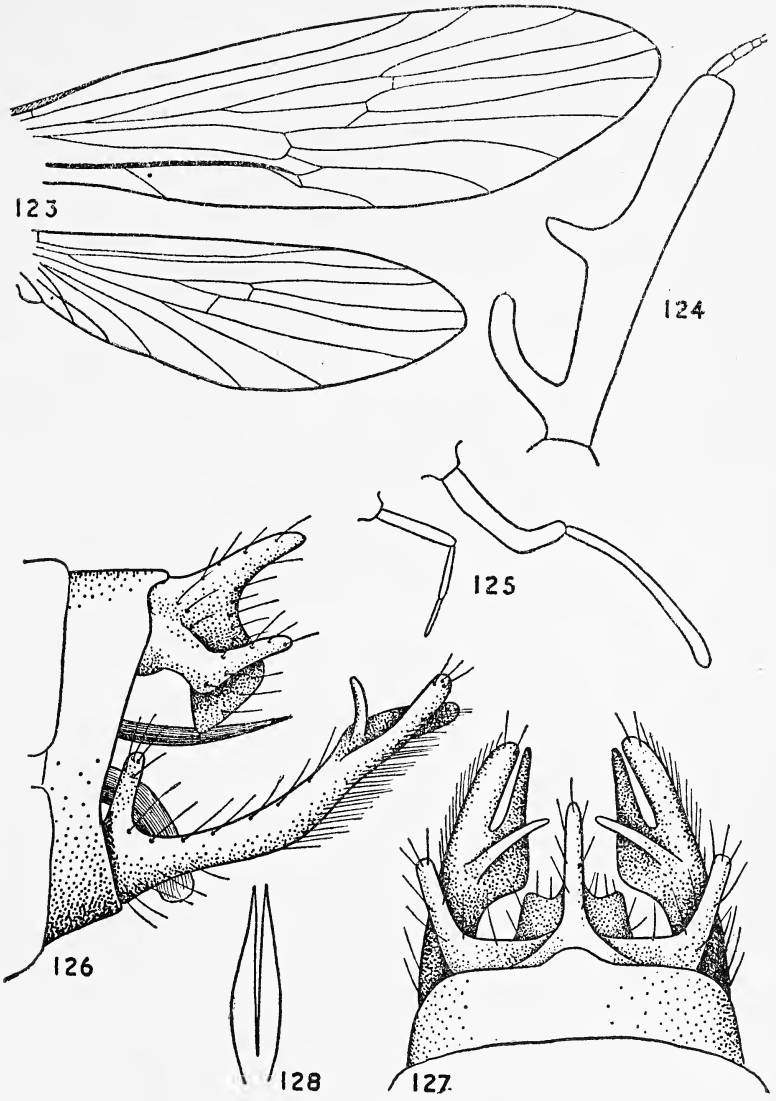
Length of the anterior wing ♂ 9 mm.

Length of the basal joint of the antenna ♂ 2 mm.

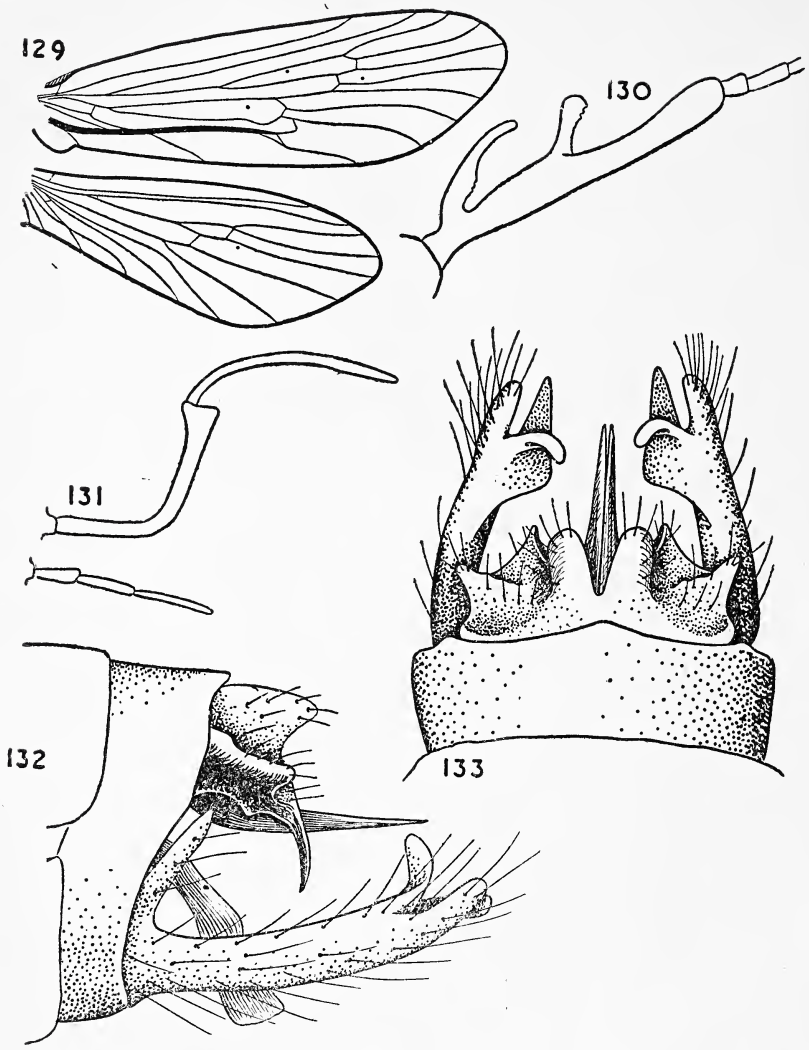
Assam.

Type ♂ in the collection of the Vienna Museum.

I am indebted to Dr. Zerny for permission to examine and refigure the type.



Figs. 123–128. *Ulmerodes armata* (Ulmer). ♂. 123, wings. 124, base of antenna. 125, maxillary and labial palpi, lateral. 126, genitalia, lateral. 127, genitalia, dorsal. 128, penis sheaths, dorsal.



Figs. 129–133. *Ulmerodes palpalis* sp.n. ♂. 129, wings. 130, base of antenna. 131, maxillary and labial palpi, lateral. 132, genitalia, lateral. 133, genitalia, dorsal.

Ulmerodes palpalis sp.n. Figs. 129-133.

Insect brown; wings broad, clothed with hairs and scales; anterior with the discoidal cell very long and narrow, longer than its footstalk; post-costal fold reaching as far as the middle of the discoidal cell and terminating at the border of the large seventh apical cellule; posterior wing with fork No. 1 sessile; basal joint of the antenna moderately long, longer than the width of the head with the oculi and armed with a pair of stout processes, the one at the base longer than the second, which is situated about halfway up; maxillary palpi unusually long, longer than the basal joint of the antenna, two-jointed, slender, basal joint elbowed and perhaps a little longer than the terminal; spurs of the anterior tibiae prominent.

Genitalia ♂.—The apical margin of the ninth tergite slightly produced at its centre; beyond it, from above, is a coronet-shaped plate, middle process rather stout, intermediate processes produced in downcurving spines, outer processes short and directed outward; penis short; sheaths long and slender, parallel, lying well above the penis; inferior appendages single-jointed and four-branched, basal branch long and slender, concealed, arising from the upper margin at the base, directed upward; the three other branches are all at the extremity of the appendage and from beneath, the lower is the broadest.

Length of the anterior wing ♂ 8 mm.

Length of the basal joint of the antenna 1.84 mm.

N.-E. Burma: Kamba'ti, 30. iv, 25. v., 1. vi. 1934, R. Malaise.

Upper Burma: Nam Tamai Valley, 16. viii, v. 1938, R. Kaulback.

Type ♂ (Upper Burma) in the collection of the British Museum, other ♂ paratypes in the Stockholm and British Museum collections.

Ulmerodes tibama sp. n. Figs. 134-138.

Insects brown. In the ♂, wings covered with hairs and scales; in the anterior, the post-costal fold rather more than half the length of the wing, with only two conspicuous cellules between it and the posterior margin, the distal cellule the larger; antenna with the basal joint long, two processes at its base, the distal the shorter and situated slightly before the middle; maxillary palpi two-jointed, joints about equal in length, basal joint irregular in shape, terminal arising before its apex.

Genitalia ♂.—Dorsal plate with the centre strongly produced in a pair of finger-like processes almost touching each other, apices slightly dilated and rounded; they arise from the centre of a wide, rectangular plate with a sinuous apical margin; lateral margins sloping to a lower level than the central, and with the angles forming small, finger-like projections directed distally; lower margin produced in a narrow, downwardly pointing plate with an obliquely truncate apex; the base of each of the central processes of the plate is produced at its lower margin in a deep keel; penis short and straight, sheaths long, apices divergent; inferior appendages

branched, a slender branch arising from the upper margin near the base, directed upward; apex of the appendage trifurcate, lower fork triangular with an acute apex, middle fork slender, outer rather stouter and strongly fringed.

Length of the anterior wing ♂ 9 mm.

Length of the basal joint of the antenna ♂ 2.44 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 1. vi. 1934, 11. v. 1934 24. v. 1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the British Museum collection.

Goerodella gen. n.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna long with either a simple branch at its base or else the rudiments of such a branch. Maxillary palpi two-jointed, the basal joint sometimes with a membranous branch or swelling at its apex, terminal joint slender. Wings clothed with hairs and scales; in the anterior, post-costal fold very short, about a third the length of the wing; in some species the costa is folded over the wing for nearly its entire length. Penis sheaths long. Inferior appendage furcate at its apex and with a basal branch less erect than usual, practically directed distally.

Genotype, *G. tesarum* sp. n.

Goerodella cornuta sp. n. Figs. 139-144.

The species is very similar to *Goerodella tesarum,* but with slight differences in neuration, particularly in the post-costal fold area. The membranous maxillary palpi are difficult to make out and may possibly differ slightly in the two species. Small differences are also apparent in the form of the basal joint of the antenna.

In the ♂ genitalia, the claw-shaped lateral angles of the dorsal plate are more accentuated in *cornuta* and, viewed from the side, there is a serrate ridge proceeding downward from the centre of the dorsal plate. Other parts are very similar in the two species which I consider, nevertheless, to be distinct.

Length of the anterior wing ♂ 10 mm.

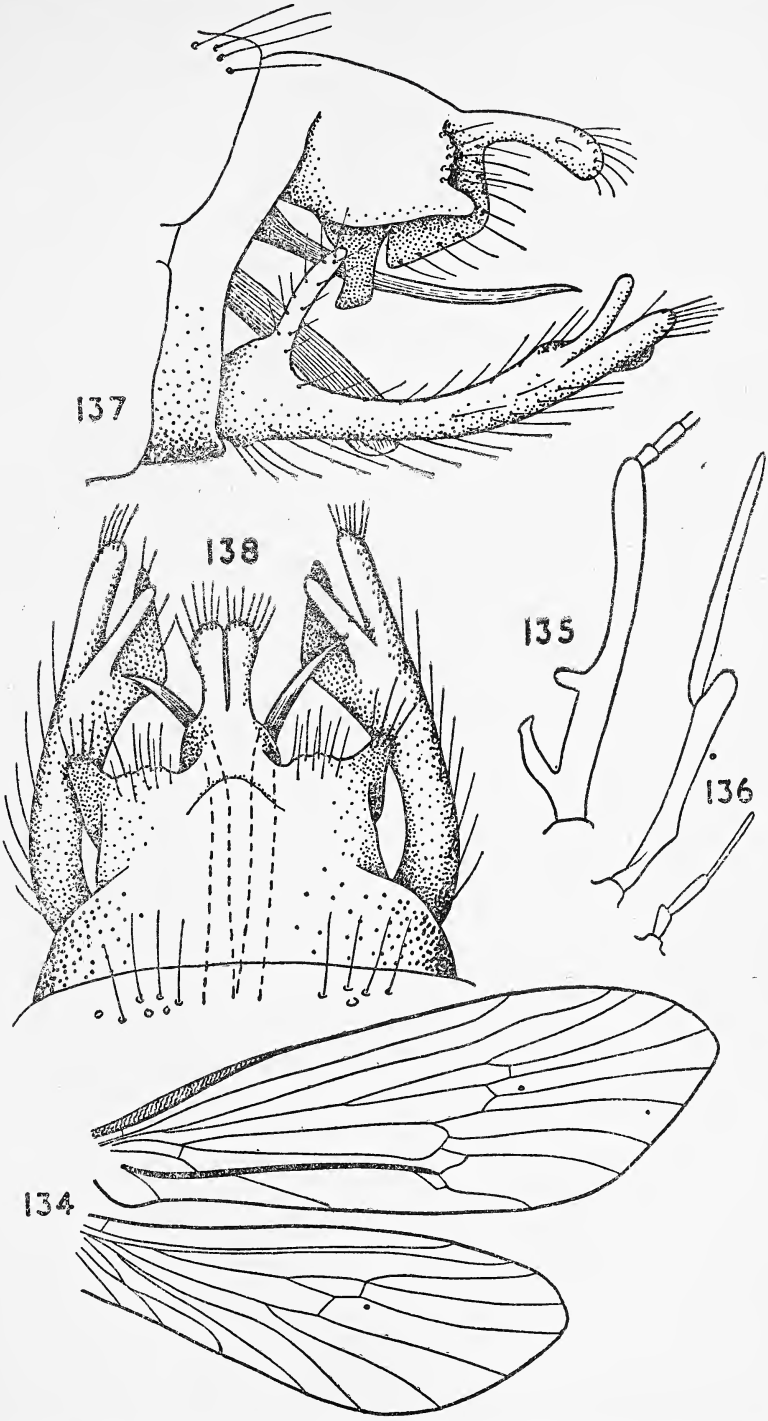
Length of the basal joint of the antenna 3.3 mm.

N.-E. Burma: Kambaiti, 9. iv. 1934, 6,800 ft.; 30. iv., 24. vi., 12. vii., 1934, 6,300 ft., R. Malaise.

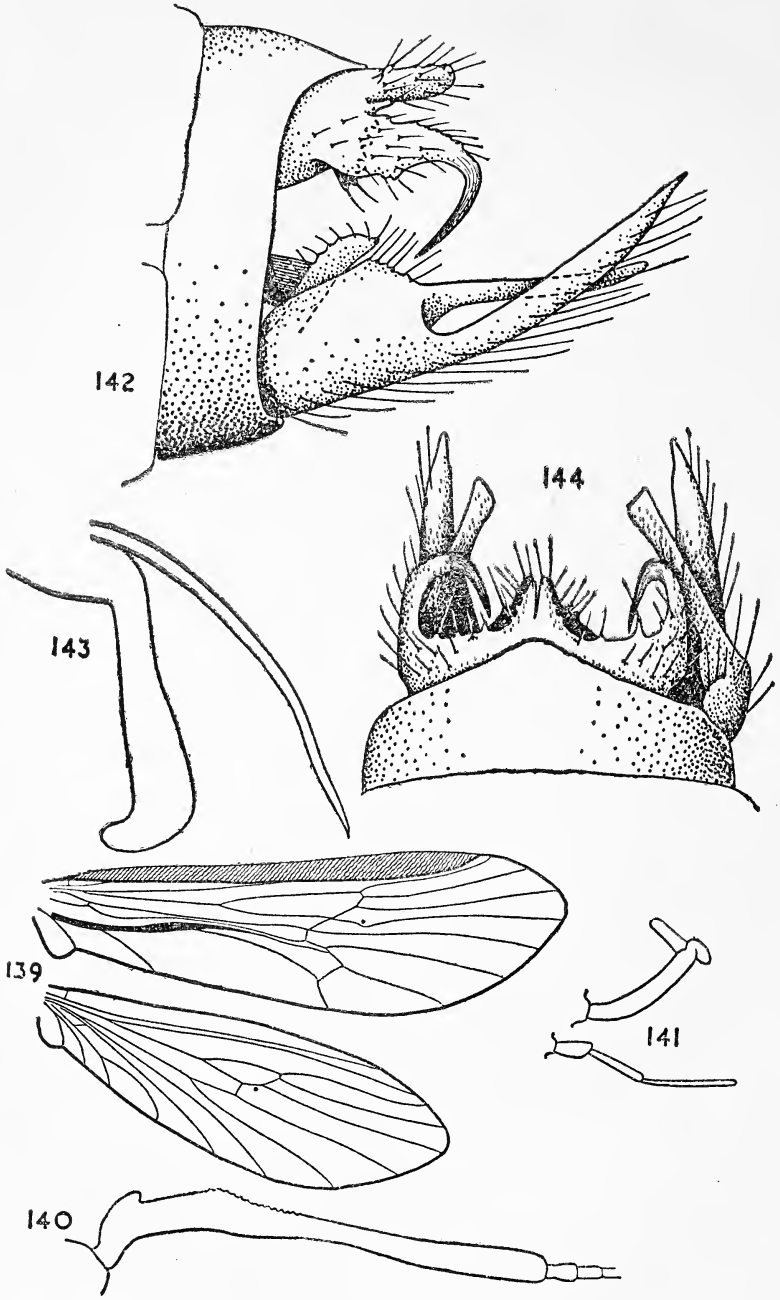
Type ♂ (30. iv. 1934) in the collection of the Stockholm Museum. Paratype ♂ in the British Museum collection.

Goerodella ramosa sp. n. Figs. 145-151.

Insects yellowish brown. In the ♂, wings covered with hairs and scales; anterior with a short post-costal fold, less than half the length of the wing, with one large cellule beneath it, besides a smaller in the anal region; fork No. 2 extending beneath the discoidal cell nearly halfway; no central fold; costa not folded over; basal joint of the antenna not very long, with a stout branch towards the base, whose apex is truncate with the lower apical angle



Figs. 134–138. *Ulmerodes tibama* sp.n. ♂. 134, wings. 135, base of antenna. 136, maxillary and labial palpi, lateral. 137, genitalia, lateral. 138, genitalia, dorsal.



Figs. 139–144. *Goerodella cornuta* sp.n. ♂. 139, wings. 140, base of antenna. 141, maxillary and labial palpi, lateral. 142, genitalia, lateral. 143, penis and sheaths, lateral. 144, genitalia, dorsal.

(from above) produced in a short claw; maxillary palpi membranous, rather narrow, apparently two-jointed but there is no very definite joining point; the second joint appears rather as a membranous extension of the centre of the basal joint towards its apex; there is a slight dilatation of the membrane at the extreme apex of the second joint, possibly the rudiments of a third.

Genitalia ♂.—Dorsal plate with the centre of its apical margin raised in a pair of ridges which, from above, appear as small central processes; at the base of these ridges, the plate is broadly extended on each side, apical margin circularly excised, outer angles forming acute claws, inner, triangular processes whose lower margins are produced to form acute, down-pointing spurs as seen from the side; penis short and rather retracted in the type; sheaths long, acute and parallel; inferior appendages branched, a slender branch arising from the upper margin towards the base, directed upward; apex of the appendage bifurcate, upper fork with its apex concave, lower fork more slender and finger-like.

Length of the anterior wing ♂ 8 mm.

Length of the basal joint of the antenna ♂ 1.7 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 24. v. 1934; 25. v. 1934; 12-17. vi. 1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum. Paratypes ♂ in the British Museum collection.

Goerodella tesarum sp. n. Figs. 152-156.

Description of the male; general appearance fuscous; basal joint of the antennae fuscous, slightly elbowed midway, without any processes at the base, but with a strong, angular projection carrying three or four large spines or spurs at the place where processes, when present, are generally situated; there are two other patches of spines on the inner surface of the base of the joint, the patch nearer the base, short, the second patch, long and slender; apex of the basal joint slightly dilated, terminal joints ochraceous; maxillary palpi two-jointed, basal joint long, dilated in a membranous sac towards the apex; beyond this the joint is sharply bent, second joint short; labial palpi, basal joint short and stout, second longer but shorter than the third; wings fuscous, with dark scales mainly confined to the nervures; anterior with no central longitudinal groove, costa folded over the sub-costa along its entire length; the fold in the post-costal region short, curving sharply upward, three cellules along the posterior border, the basal cellule the smallest and the median, the largest; in the posterior wing, the fourth apical cellule extends further inwards than the base of the discoidal cell; a long pencil of yellow, silky hairs arising from the anal angle legs ochraceous.

Genitalai ♂.—Ninth tergite produced at its centre in a broad-based triangle, beyond which is a wide, dorsal plate produced and excised at the centre to make a pair of triangular processes, outer angles produced and triangular, with the apices of the triangles produced again in long, downwardly directed spines or spurs; penis short, straight; sheaths asymmetric but not directed to one side

as in the *Dinarthrum* species; inferior appendages single-jointed, bifurcate from about midway, upper fork rather more slender than the lower, about equal in length, apex clavate, lower fork with the apex sinuous; a third branch arising from the inner surface towards the base; lower margin of the ninth segment with a central excision, and a triangular projection opposite the base of each appendage.

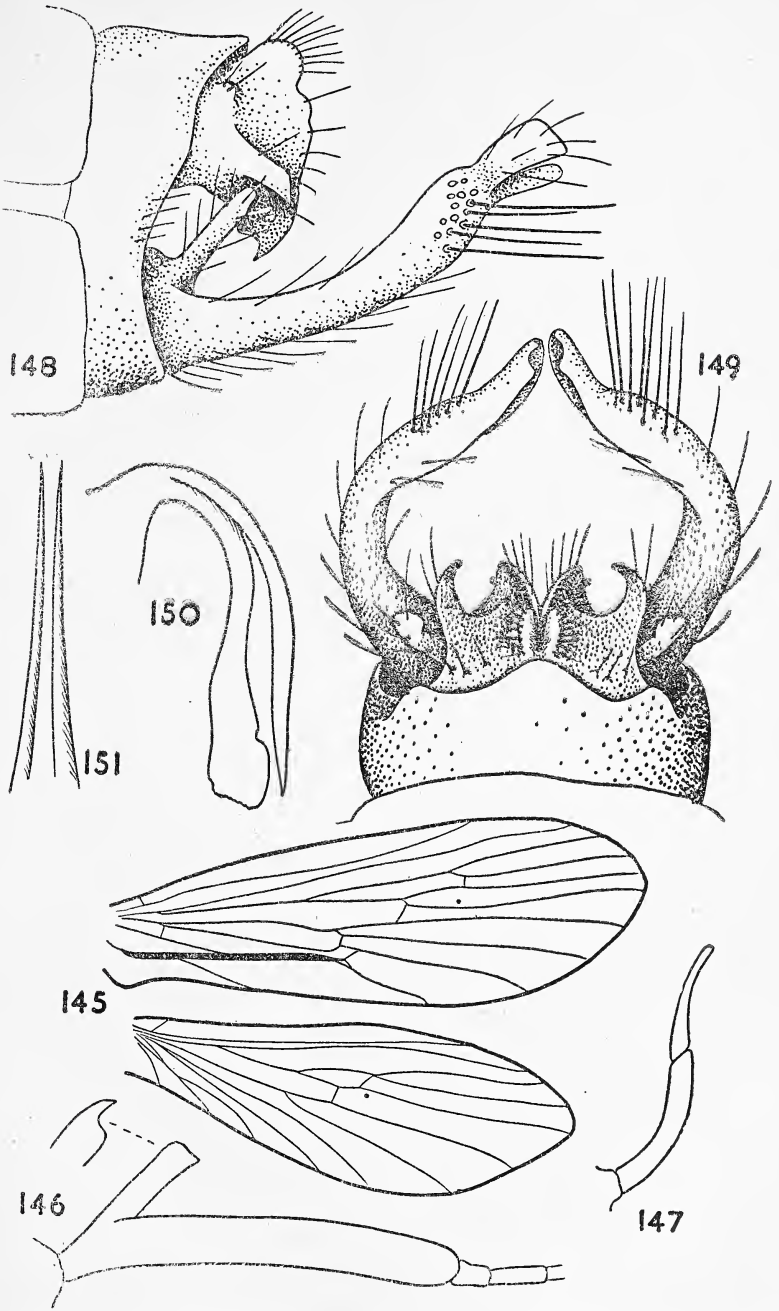
Length of the anterior wing ♂ 10 mm.

Length of the basal joint of the antenna 3.3 mm.

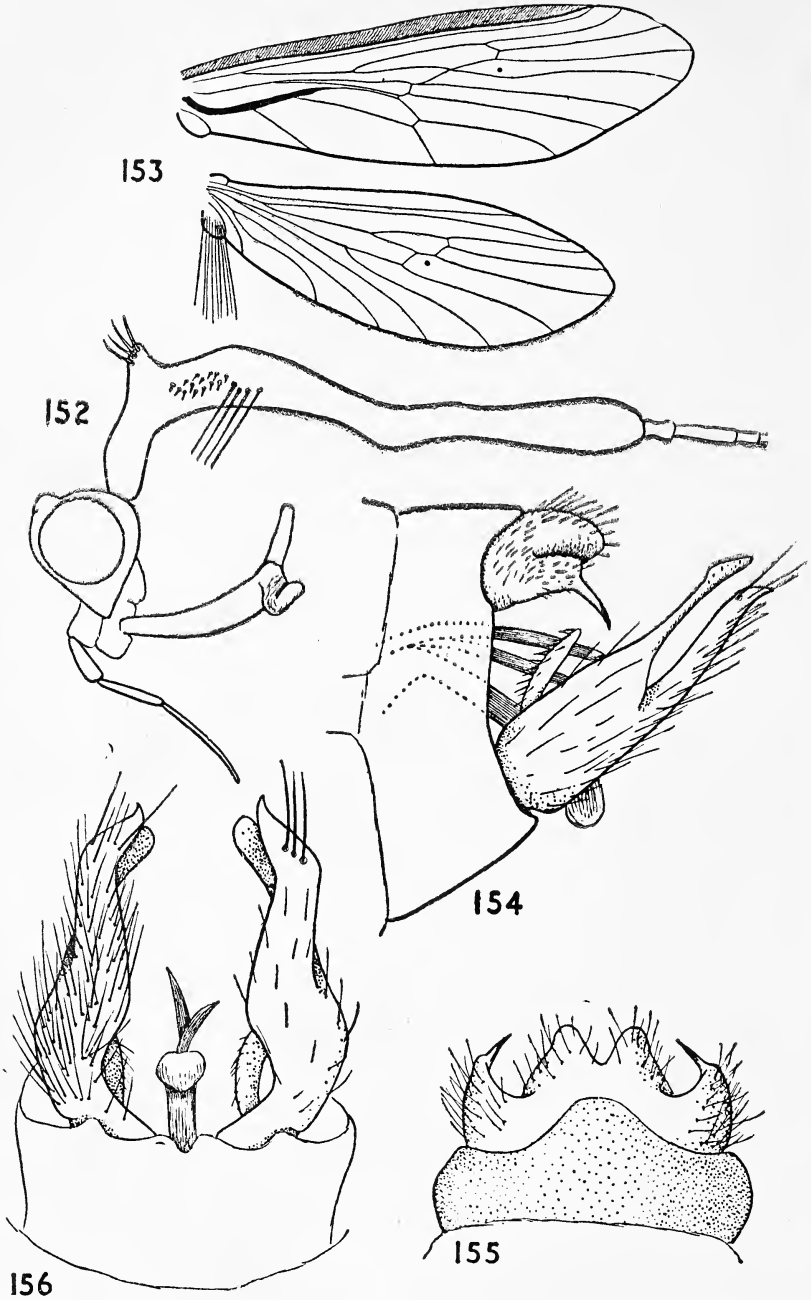
Kumaon: Muktesar, 7,500 ft., 29. ix. 1922, Fletcher Collection.

Type ♂ in the collection of the British Museum.

(To be continued)



Figs. 145–151. *Goerodella ramosa* sp.n. ♂. 145, wings. 146, base of antenna, with inset of apex of process, dorsal. 147, maxillary palpus, lateral. 148, genitalia, lateral. 149, genitalia, dorsal. 150, penis and sheaths, lateral. 151, penis sheaths, dorsal.



Figs. 152–156. *Goerodella tesarum* sp.n. ♂. 152, head from side. 153, wings. 154, genitalia, lateral. 155, ninth segment and dorsal plate, dorsal. 156, ninth segment, inferior appendages and penis, ventral.

SEX RATIOS IN INDIAN BATS

BY

HUMAYUN ABDULALI

In Vol. 47 of the *Journal* (No. 3, p. 522), I wrote a note on bat migration in India and referred to the book by Norbert Casteret which prompted the enquiry. I have now had access to a new book by the same author 'My Caves' (J. M. Dent & Sons Ltd., London, 1947) in which the last chapter is called 'Three Years With The Bats' and contains some additional information which should be of interest to naturalists in this country.

Reference is made to some caves on the French side of the Pyrenees where three species of bats exist; *Rhinolophus* (Horse-shoe bats), *Miniopterus* (probably *M. schreibersi*) (Long-winged bat) and the larger *Myotis myotis* (Mouse-eared bat) which is the mainstay of his study. These three species are a little confused in the English translation and we have only been able to sort them out with the assistance of Mr. R. W. Hayman of the British Museum.

Casteret's observations were first undertaken in November when there were a dozen *Rhinolophs* or Horse-shoe bats which remained in the caves through the winter months in a state of almost absolute torpor. On 5th April numbers of the larger Mouse-eared bat arrived and 225 bats, captured with butterfly nets, were ringed with aluminium cylinders slit on one side, which were gently closed over the bat's *fore-legs* (probably mis-translation for fore-arms) so that they could still slide up and down. With the arrival of migrants the *Rhinolophs* almost disappeared.

In the evenings, the Mouse-eared bats did not leave the cave all together like a flock of birds, but the first exit was noted about 20 minutes after sunset, five bats leaving in five minutes. Subsequent departures were counted over 5-minute periods and one set of figures recorded is 5, 11, 14, 25, 63, 135, 197 and 260. After reaching this maximum the rate diminished to 131, 58, 16 and 4; the last 4 left 55 minutes after the first.

It is suggested that bats exude oil from their nose glands which they rub on to their wings as protection against climatic conditions. This process is impracticable while in their crowded roosting (day) positions. It has to be gone through when the 'swarm' breaks up in the evening and the individuals have more room to move about and apply their toilette. It is said that one bat, hanging head downwards as usual, was seen to go through a lengthy process of folding and unfolding its membranous wings and drawing them with a slow sweeping movement across its nose.

These bats stay till August and their numbers vary between 400 and 1,000—the larger the number the longer it took to empty the cave, which really remained completely deserted only for two hours. Their return was spread over a much longer period than

the exit time, probably depending upon their success in hunting insects.

They are sensitive to changes of weather. Cold, wind and rain may restrict or completely suspend their exodus. Every year at the beginning of June they leave their homes earlier in the evenings in some cases only 10 minutes after sunset.

Of the thousands of *Myotis* handled and ringed over several years, Mr. Casteret did not come across a single male and believes that the mating must have taken place in autumn at some other place, gestation commencing only in spring. 'The caves in the Pyrenees are therefore a maternity home where the young ones are born at the same time, almost all on the same day. . . . In the swarm, the young can sometimes be seen crawling over the tangle of bodies, burrowing into the mass with plaintive squeaks, in order to be fed by other females. So highly developed is the herd instinct in these bats that the mothers appear to have no recognized offspring. It is difficult to accept the view that hundreds of nurses on their return from hunting can recognise their own babies in the swarm of small bodies. . . . I have often separated babes from mothers and entrusted them to other females and the adoption has followed at once.'

It is recorded that when the young are 25 to 30 days old 'the mothers cannot fly about with so heavy a burden and when night comes they bite their babies to make them let go. The latter protest loudly and the din is deafening. At last when they have been duly chastened, that is to say nipped, they cling to the corrugations of the roof and the mothers go off on their nightly flight alone. For two or three hours the cave then contains nothing but the infant population. They are a rowdy lot and keep up a continual chirping like that of chicks.'

Males born in the caves never come back while the young females will return every year with their mothers and, later with their daughters, the same individuals having returned to the caves for three years.

While the spring arrival is spread over six or seven days, a general departure in a single night seems to take place about 20th August.

Their arrival coincides with that of the first swallows and it is suggested that they fly with the birds. The following instances are quoted:

'A German naturalist, Otto Hepp, had noticed on a fine autumn afternoon in 1890 a number of bats among a flight of swallows crossing the river Main about two hundred feet above it. Otto Hepp was a serious student but a very old man. No one doubted his sincerity, but it was thought his eyes had played him false.

'However, on 25th September 1933 two other German naturalists, von Finkenstein and Schafer, were amazed to see a similar phenomenon near the small lake of Ullersdorf in Upper Lusatia. In an hour and a half they counted some five hundred bats flying with some house-martins towards the south.'

'Finally, in October 1935, M. G. Hugues, son of the eminent and late-lamented French naturalist, Albert Hugues, detected bats flying with swallows against a dark sky at Romans in Drome.'

As further evidence of their migration 165 bats were ringed at a place about 10 miles from the cave in a direct line and individuals from this flight obtained at the caves on the following morning. A further release of 65 *Myotis* from a distance of 22½ miles also resulted in 8 of these being recovered at the caves three days later. A third release of 120 bats at a distance of 60 miles yielded no result for some time, but a month later several 'returns' were collected. Several other releases were made at varying distances and the furthest return was over a distance of 165 miles in a straight line. The time between release and return is not however indicated but these interesting facts will only go to show how much is still unknown about the habits and movements of these small mammals which are so near to us.

There is of course more information about European bats (e.g. in 'A History of British Mammals, by G. E. H. Barrett-Hamilton) but the material from the Caves book is summarised merely to give readers in India an indication of possibilities of work in our area. Except for a few notes in Blanford's Fauna, our information is non-existent. Blanford states that in 'temperate regions bats hibernate in winter, a number of them being frequently found huddled together. Some observers have supposed that no hibernation takes place in India but the insectivorous forms in Northern India at all events, are but rarely seen abroad during the cold season though the *Pteropodidae* are as active as at other times'. Subsequent to this, under several species e.g. *Rhinolophus luctus* and *affinis*, Capt. Hutton is quoted as stating that 'in Mussoorie they appear only during the warmer months of summer, remaining in a semi-torpid state during the winter.'

The haunts of bats are usually well marked, and regular notes kept over any length of time in different places should give us some information, though of course the ringing method would always be the most reliable.

Mr. Casteret's reference to the absence of males in the caves examined by him has prompted me to go through the records of the Mammal Survey conducted by the Bombay Natural History Society many years ago. An analysis has been made of the specimens obtained during this survey and we find that of a total of 5609 specimens collected only 39% were males. A detailed statement of the same is appended herewith. It will be noticed that in 25 species the males are in a minority ranging from 14.7 to 47% while the average of various species (consisting mostly of those forms of which less than 10 specimens were obtained) the male percentage is also only 42.8.

In only two species i.e. *Hipposideros lankadeva* and *Taphozous melanopogon* do the males exceed the females. In the last species the figures appear to be clear that there is always a preponderance of males, and it is curious that this is the only species in which there is

a marked external sexual difference between the sexes i.e. the beard of the male.

The specimens were obtained over a large number of camps (about 50 separate collections are listed) ranging from Ceylon, through Kanara, Mysore, Poona, Gujerat, Kathiawar & C.P. into the Kumaon and Eastern Himalayas and then down into Burma.

In the following table the first figure in parenthesis after the name indicates the number of different camps from which this

SEX RATIO IN SPECIES OF BATS OBTAINED BY THE SOCIETY'S MAMMAL SURVEY OF INDIA, BURMA AND CEYLON

	Species	Males	Females	% Males
1.	Rousettus seminuda (1, 0) ...	5	29	14·7%
2.	Rousettus leschenaulti (9, 0) ...	55	97	36·0%
3.	Myotis peytoni (1, 0) ...	7	35	16·6%
4.	Rhinopoma hardwickii (1?, 2) ...	47	129	26·7%
5.	Rhinopoma kinneari (7, 2) ... (both at Jamnagar and in Cutch only 11 males each were obtained.)	33	68	32·6%
6.	Rhinolophus lepida (8, 0) ...	28	67	29·4%
7.	Rhinolophus rouxi (8, 3) ...	43	85	33·5%
8.	Hipposideros fulvus (27, 0) ...	99	228	30·0%
9.	Hipposideros speoris (8, 1) ...	118	197	37·4%
10.	Hipposideros armiger (10, 3) ... (once 15 males to no females in Nepal)	89	123	42·0%
11.	Hipposideros larvatus (2, 1) ...	73	91	44·5%
12.	Hipposideros lankadeva (4, 3) ...	34	29	53·9%
13.	Taphozous longimanus (15, 2) ...	63	137	31·5%
14.	Taphozous melanopogon (11, 10) ... (except for 11 females only at Rajkot and 19 males only at Kanara, both sexes were obtained in all areas)	142	68	67·6%
15.	Cynopterus sphinx (23, 2) ...	61	127	32·4%
16.	Tylonycteris pachypus (8, 0) ...	13	27	32·5%
17.	Megaderma spasma (12, 1) ...	30	58	34·0%
18.	Hesperopterus tickelli (4, 0) ...	7	13	35·0%
19.	Lyroderma lyra (24, 1) ... (once 39 males to 24 females)	168	299	35·9%
20.	Pipistrellus mimus (27, 6) ... (12 females to no males in Gujerat)	149	228	39·5%
21.	Pipistrellus ceylonicus (15, 1) ...	54	81	40·0%
22.	Pipistrellus coromandra (19, 2) ...	112	150	42·7%
	Miscellaneous species ...	429	572	42·8%
23.	Scotophilus kuhli (26, 3) ...	143	210	40·5%
24.	do. wroughtoni (15, 3) ...	101	146	40·9%
25.	Laponicteris kachensis (11, 2) ...	91	131	40·9%
26.	Scotozus dormeri (10, 1) ...	28	35	44·4%
27.	Nyctinomus tragatus (5, 0) ...	8	9	47·0%
	TOTALS ...	2,230	3,469	39·1%

species was collected, and the second the number of occasions on which the males exceeded the females. This is indicated only when the total of specimens of a species from a camp is over 5. The various species listed are from all the four sub-families of bats

represented in the Old Fauna and this preponderance of females seems to be a condition which affects the whole family. . . A further investigation into the habits and social lives of the many species, particularly of *Taphozous melanopogon* (there is a colony in the main cave at Kanheri, near Bombay) would be of considerable interest.

Hodgson is reported to have observed that in *Lyroderma lyra* the males greatly exceed the females, but in view of our figures (obtained over 24 camps) it is perhaps permissible to assume that his collections were made from male colonies. It is apparently customary for the two sexes in many bats to live apart except in the pairing season (Old Fauna p.258).

After compiling the above we have noticed a passage on page 39 of 'A History of British Mammals' reading:

'Many naturalists, from Spallanzani downwards, have referred to a supposed preponderance in number of the female sex. On this point no satisfactory evidence is forthcoming, but the apparently superfluous size and capacity of the male generative organs would be accounted for if it could be shown that bats are polygamous.'

SPECIATION IN THE GROUP OF GREAT REED-WARBLERS

BY

E. STRESEMANN AND J. ARNOLD

(With a plate and 6 text-figures)

THE PROBLEM

Many difficulties involved in the classification of closely similar forms have disappeared after the eminent importance of isolation as a factor in evolution had been correctly understood. The formula 'similarity coupled with geographical separation' has since been accepted as the touchstone of trinomialism by an increasing number of taxonomists, and whenever that condition is fulfilled two compared forms are considered members of the same species or 'Rassenkreis'.[1]

In contrast to 'geographical separation', the concept of 'similarity' is a very elastic one, and there have been, in recent years, quite a number of authors who indulged in its utmost extension, because they wanted to reduce the number of species as much as possible. By employing this method they expected to serve the demand for simplification of the system. Simplification has in fact been the result, simplification however at the expense of incontestability. The fundament of the judgment thus attained, often rather airy, cannot be based on precise facts, but merely on the hypothesis that the two compared forms, separated by a distributional gap, would *probably* hybridize if meeting each other.

When wanting to support such a theory one should, however, not only point to the similarity of the forms in question, but it seems of equal importance to emphasize the characters by which they differ, and to examine the biological value of these differences, not only of colour and structure, but also of ecology, behaviour, food, moult, migration, and so on. Many large 'circles of races' which have been constructed within the last ten or twenty years will shrink again when ornithologists become better acquainted with the biology of the forms at present connected by taxonomists for convenience only.

Assertions cannot be disproved by assertions. Such cases therefore deserve to be treated in some detail for which it can be shown that the principle of simplification has been overdone.

An example of that kind is furnished by the Great Reed Warblers which range from the Baltic Sea and the Amur river down to Australia. These were divided in 1909 by Hartert into three species: (1) *Acrocephalus arundinaceus* (*arundinaceus* + *zarudnyi* + *orientalis*); (2) *Acrocephalus stentoreus* (*stentoreus* + *brunnescens*); (3) *Acrocephalus australis*. In 1924 however, when reconsidering the matter, Hartert came to the following result: (1) *A.*

[1] Rassen = races, Kreis = circle.

arundinaceus (*arundinaceus* + *zarudnyi*), (2) *A. stentoreus* (*stentoreus* + *brunnescens* + *orientalis* + *australis* and the rest of the Indonesian forms).

Soon afterwards Salomonsen (1929), progressing in the same direction, merged all these forms into one single 'Rassenkreis' which had to bear the name *Acrocephalus arundinaceus*. His view has been accepted by Hartert and Steinbacher (1934), by Dementjew (1935), by Stresemann (1940) and quite recently by Mayr (1948).

In spite of this consensus of experienced taxonomists the arrangement proposed by Dr. Salomonsen cannot be maintained, as shown by our map from which it becomes apparent that two forms are co-existing along the eastern border of Lake Aral and its affluent, the Lower Syr Darya. Though this fact, emphasized by its discoverer Sarudny in 1916 already, has been mentioned by Salomonsen, he seems to have known it from second hand only; otherwise his map of distribution and his systematic conclusions would have been in better accord with reality. Sarudny had taken a small boat to explore the eastern shores and islands of Lake Aral after reaching it by the delta of Syr Darya. From 28 June to 26 July, 1914, he collected birds at many spots down to his turning point, the mouth of the Dshany-darya. He condensed his experiences in the following notes:

'*Acrocephalus arundinaceus zarudnyi* is one of the commonest birds in the reeds covering the delta of the Syr Darya. He occurs in great numbers at lake Kamyshly-bash and lake Tshe-bash. We found him equally frequent among the reed thickets of Kuiljus. Further southwards we met him along the eastern shore of Lake Aral and the opposite islands as far as the estuary of the Dshany-darya; but beginning with the reeds of the islands Dambaly, Silyawa, Dshurpass, and Menshikow he becomes far less frequent than *A. a. brunnescens*, and in the estuary of the Dshany-darya (25-26. vii.) he seems to be rare.

Acrocephalus arundinaceus brunnescens. During our voyage from north to south along the eastern shore of Lake Aral, this form was first met with by us in the reeds of the delta of the Syr-Darya (28. vi.), where it breeds in very insignificant numbers, hardly making itself apparent amidst the masses of *A. a. zarudnyi*.

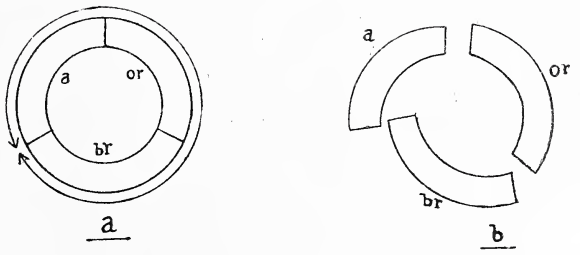


FIG. 1 (for explanation see p. 439)

Further to the south it becomes more and more frequent, being already common on the island Atalyk, though still outnumbered by *A. a. zarudnyi*. But starting with the islands Dambaly, Dshurpass

and Menshikow, besides on Uyaly and Usun-Kain, the reverse becomes true more and more, to the effect that *A. a. zarudnyi* has to be considered here of rare and (perhaps) casual occurrence.'

These remarks ought to have forced Dr. Salomonsen to accept at least two species of Great Reed Warblers instead of a single one only. Our distrust, once awoken, did not stop at this point. We thought it advisable to examine anew the relations of all forms

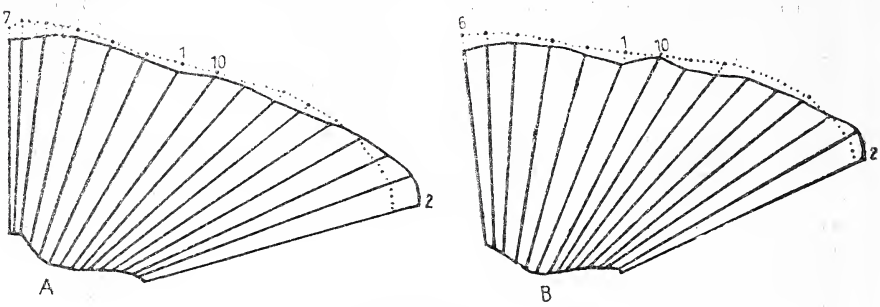


FIG. 2 (explanation on p. 439)

to their geographic neighbours. The result is herewith presented to the judgment of ornithologists.

It may be stated in advance that we consider certain differences of wing structure to be of considerable phylogenetic age, i.e. those which are shown in our figures 2 A and 2 B. Accordingly we feel induced to accept three species of Great Reed-Warblers:

(1) *Acrocephalus arundinaceus,* with the races *arundinaceus, zarudnyi* and *griseldis.*

(2) *Acrocephalus stentoreus,* with the races *stentoreus, brunnescens* and the Indonesian group.

(3) *Acrocephalus orientalis.*

WING STRUCTURE

The wing structure is best shown by expanding the fore limb. If through this procedure the quills are given their functional position, the real meaning of certain specific differences will become apparent, differences which have been discovered many decades ago when they were registered by the name of 'wing formula', i.e. of the reciprocal distance of the tips of the primaries in the folded wing.[1]

The average wing formula reads in:

A. arundinaceus: $3 \underset{=}{>} 2 > 4 > 5 > 6 > 7$

A. stentoreus: $3 = 4 > 5 > 2 > 6 > 7$

A. orientalis: $3 > 2 \underset{=}{>} 4 > 5 > 6 > 7$

[1] As far as we know, the German ornithologist J. H. Blasius (1840) was the first author to use the wing formula as a diagnostic character in birds.

The outline of the expanded wing of *A. arundinaceus, A. stentoreus* and *A. orientalis* is shown in the figures. For this purpose three specimens were selected which agreed in tarsal length and, therefore, may have been of equal body weight.[1] The wing area of these three specimens is almost the same, the outline however different, *A. arundinaceus* having a longer wing tip and shorter secondaries if compared with *A. stentoreus*. In this regard, *A. orientalis* stands between the two other species.

Fig. 3 shows the difference in formation of 'slots'.[2] Let us first examine the *outer web* of the distal primaries. In *A. arundinaceus* it is only the 3rd primary which is distinctly emarginated in its distal third and thus becomes a 'finger', while it is the 3rd and 4th in *A. stentoreus*. Functionally linked with this difference is the difference in outline of the *inner web*. The occurrence of a (more or less distinct) notch of the inner web is restricted to the 2nd primary in *A. arundinaceus,* while it occurs on the 2nd and 3rd in *A. stentoreus*. *A. orientalis* represents an intermediate stage in this respect also.

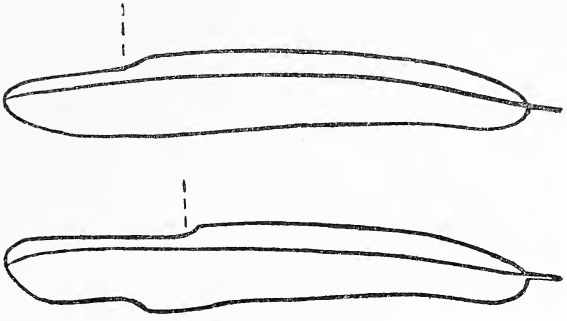


FIG. 3 (explanation on p. 439)

In order to understand the meaning of these structures it is indispensable to call to mind what is known about the dynamics of a wing stroke (for details see Graham, 1930 and Sick, 1937). During the down-beat of the expanded wing all distal primaries become pronated passively, and their tips bent upward, as clearly shown in K. Zimmer's slow motion film (Zimmer 1943, tab. xiv). In Passeriformes it is the 2nd primary which is most exposed to the twisting air forces, because it can lean itself at the rear only and not in front. This seems to be the reason why the 2nd primary tends to be shorter than the 3rd even in 'pointed' wings; the latter, supported by two neighbours, being better fitted for becoming the longest primary of the wing. The advantage of a 'blunt' wing, in which the 5th or 6th primary surpasses the 2nd, 3rd and 4th, probably consists in its greater stability during the

[1] The body weight of Great Reed-Warblers seems to be unrecorded, with the exception of *A. arundinaceus arundinaceus*.

[2] This term has been adopted here from Graham, 1930, *q. v.*

down-beat; this advantage however is gained at the expense of propulsory effect.

Passive twisting of the free 'fingers' offers an aerodynamic advantage: for 'fingers' rigidly projecting from the wing plane would not fail to cause aerial eddies counteracting the propulsory forces. Only if twisted in pronatory manner do they attain a position relative to the passing air in which both useful components, the uplifting as well as the propulsory force, are greatest (Zimmer 1943, fig. 8).

It is significant that only the tip of the wing, broken up into individual 'fingers', becomes subject to these aerodynamically favourable torsions, without involving the whole structure of the wing plane. This has been attained with the help of certain supplementary devices: the emargination of the outer web, and, to some degree, of the inner web, in both cases within the distal portion of the primary only, starting with the point where the respective feather begins to project from the wing plane like a finger. This fact explains why the notch of the inner web of a given primary corresponds to the point where the outer web of its proximal neighbour starts to become emarginated; for from this mark onward the feather may project into the air without touching its neighbours, and is capable of becoming twisted towards the line of the air-stream without any restraint.

In Passeriformes the 2nd primary always lacks the emargination of its outer web, because there is no distal neighbour to lean on. It is only from the 3rd onward that this device is found. In migratory species it tends to be best developed in the 3rd and 4th, and in such a case the inner web of the 2nd and 3rd shows a 'notch', besides being more or less distinctly emarginated.

We consider all differences of wing structure which have been found to exist between *A. arundinaceus* and *A. stentoreus* to be morphological expressions of differences in the use of the wing. This interrelation seems obvious with regard to the difference of outline. All races of *A. arundinaceus* are known to be true migrants which cover great distances twice a year, while the races of *A. stentoreus* are either sedentary or migrants to a far lesser degree only. The former group had therefore to develop a more 'pointed' wing: In connection with increased need for propulsory efficiency of its beat the wing had to become longer. The simplest means of meeting this demand consists in increasing the length not of the distal wing bones, but of the distal primaries (2nd to 4th), which thus become a longer propulsing lever. Apparently this is a reversible process: if less intensely used again, the wing tip tends to become more rounded, with the 5th and 6th primary increasing in length at the expense of their distal neighbours.

It seems probable that some functional explanation will one day be given also for the other differences, that exist between the wings of *A. arundinaceus* and *A. stentoreus*—differences not only of the number of 'slots', but also of their length. Such a theory will have to be supported by the study of analogous cases which are furnished by other species of well-known habits.

Systematic Position of the Forms *griseldis, orientalis* and the Indonesian Group.

(1) *griseldis*. (We have not been able to examine a specimen and therefore are compelled to rely on literature only). This form, though agreeing with *arundinaceus* in wing structure, shows so many differences in other respects that Ticehurst (19) decided to treat it as a separate species. It lacks the faint striping of the throat, the tail is shorter and more graduated, the bill longer, the colour and relative size of the eggs, and in addition the shape of the nest, are said to be quite distinct from *arundinaceus*. The breeding range seems isolated from that of other Great Reed-Warblers. We feel inclined to consider *griseldis* an early offshoot of the *arundinaceus*—branch, and therefore employ the symbol *Acrocephalus* (*arundinaceus*) *griseldis*.

(2) *orientalis* has been judged by earlier authors, including Hartert 1909, to be a subspecies of *arundinaceus*; in 1924 however Hartert treated it as a member of the 'Rassenkreis' *stentoreus*. With regard to structure it stands between *A. arundinaceus* and *A. stentoreus brunnescens*, while in colour of plumage it hardly deviates from *A. arundinaceus*. The colour of the feet is said to differ from *A. arundinaceus* as well as from *A. stentoreus*, by being more bluish or lead gray, less brownish gray. Whereas Stegmann (1929) claims its song to be absolutely the same as that of *A. arundinaceus*, it has been declared by Jahn (1942, p. 158), from his experiences in Japan, to differ considerably, chiefly by lacking the trenchant *Karre-kiet* component.

The breeding range of *orientalis* seems to be isolated from both its neighbours *A. arundinaceus zarudnyi* and *A. stentoreus brunnescens*. For lack of nature's experiment we think it advisable to leave the question of affinity undecided and to give this form the rank of a separate species, *Acrocephalus orientalis*.

(3) *The Indonesian forms*. A group ranging from the Philippines to Southern Australia and New Britain. All Indonesian Reed-Warblers are closely related to each other, differing chiefly in size and relative length of bill. 3rd and 4th primary emarginated as in *A. stentoreus*. Wing very 'blunt', the primaries 3, 4, 5 being equal in length and longer than the 6th, 2nd, 7th.

This assemblage may be regarded as an offshoot of the *stentoreus*-branch which reached the Philippines via Formosa and thence spread to Celebes, the Lesser Sunda Islands, Australia, etc. (see map).

Complete isolation of many small populations has favoured the evolution of races, which however tend to be rather faintly differentiated. From this fact it may be concluded that the Great Reed-Warbler started its conquest of Indonesia not earlier than during late Pleistocene times, after having given rise to some ancestral form which, owing to the effect of tropical climate, had decreased in size and, owing to its strictly sedentary habits, had acquired a rounded wing.

We agree with previous authors (Hartert 1924, Stresemann 1924) in judging all Indonesian races to be members of the species *Acrocephalus stentoreus*.

Migration

The forms treated in this article are partly sedentary, partly migratory.

All Reed-Warblers breeding within the tropical zone are strictly sedentary, i.e. most forms of the Indonesian group and the southern populations of *A. stentoreus brunnescens*. Besides, *A. stentoreus stentoreus* stays all the year round in Palestine and Egypt.

The northern populations of *A. stentoreus brunnescens* differ in this respect from the more southern ones by performing migrations to distances of 1,000 km (or even more). The same seems to hold true in Australia, where the southern populations of the local Reed-Warbler are known to leave their breeding range in autumn. In both cases the wing structure of migratory and non-migratory populations is still the same. We may argue from this fact that the difference in habits is of relatively short tradition.

A. orientalis and all subspecies of *A. arundinaceus* (including *griseldis*) are true migrants which pass the off-season in some rather distant tropical area (see fig. 4).

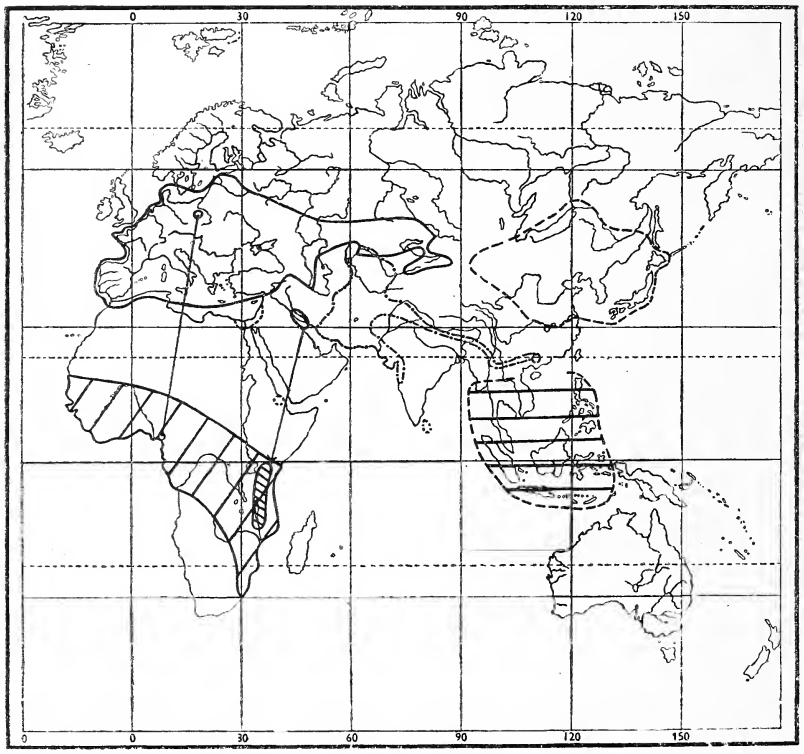


Fig. 4 (explanation on p. 439)

In order to reach their winter quarters the European populations of *A. arundinaceus* seem to migrate in a southern direction[1], while

[1] Our map (fig. 4) shows two points of the migration route of a specimen ringed on 1. vii. 1935 in Geppersdorf (Silesia) and secured 5. iv. 1937 Nbasi (Nigeria), 5,280 km. distant. (Creutz, 1937).

Photo *R. S. P. Bates*

Indian Great Reed-Warbler (*Acrocephalus stentoreus brunnescens*) on nest

the Asiatic populations have to follow a more or less southwesterly course. A remarkable crossing of flight lines takes place in the Amu Darya region and Persia, where *A. arundinaceus zarudnyi,* arriving from the Tarim basin and tending towards East Africa, meets *A. stentoreus brunnescens* which directs its flight to the Mekran coast or N.W. India.

Moult

The general moulting scheme followed by all Great Reed-Warblers seems to be:

Nestling plumage (followed by body moult at the age of a few weeks, beginning soon after leaving the nest), first autumn plumage (followed by first complete moult at the age of about 6 months), first annual plumage (followed by second complete moult at the age of about 1½ years), second annual plumage, etc.

All migratory forms apparently undergo the first complete moult in winter quarters; as a rule, this moult seems to take place at a later date than the complete moult of adult specimens. According to Whistler (in Ali and Whistler, 1936) *brunnescens* changes all the plumage only once a year, from September to November. The same may be true for *A. arundinaceus* and *A. orientalis,* though this assumption is not in accordance with that of Witherby (1938) who supposes *A. arundinaceus* to undergo two complete moults in Africa, one after arriving there and a second before spring migration. The matter needs to be studied anew.

Ecology

All Great Reed-Warblers agree in the construction of the nest (a very deep cup with strong walls, the edges of which are slightly bent inward) which may be regarded as an adaptation to the effect of wind in reed belts. (Plate) They are typical inhabitants of the latter, favouring the reeds even in winter quarters. There are exceptions, however.

In Lower Egypt and in Southern Palestine *A. stentoreus stentoreus* may be found in *Papyrus* swamps, and on islands in the southern Red Sea even in mangroves. Heuglin (*J. f. O.* 1868, p. 136) discovered a nest in the fork of a mangrove bush (*Avicennia officinalis* L.) at the height of 1 meter, its cup being somewhat shallower than in the case of reed-nesting *A. arundinaceus.* The same ecological change has been recorded from the Mekran coast, where *A. stentoreus brunnescens* has become an inhabitant of mangrove forests and been supposed to construct its nest in the branches (Ticehurst, *Ibis* 1922, p. 549). The *tertium comparationis* between reed belt and mangrove forest consists in the presence of water covering the ground.

Originally the reverse process seems to have given rise to the ecological specialisation of the Reed-Warblers, for they are in all probability descendants of some group of bush-haunting warblers (closely related to the present genus *Hippolais*) which show some degree of preadaptation to nesting within the reed belt by their method of fastening the nest to branches or stalks.

History of Dispersal

The original home of the true Reed-Warblers (*A. arundinaceus A. stentoreus, A. orientalis, A. scirpaceus*) may have been some region which, by being poor in bushes and rich in reeds, offered special advantage to certain pre-adapted species which were able to settle in that still unoccupied ecological niche. Such type of vegetation is characteristic of the borders of great deserts; in our day it is to be found along Lake Aral and its affluents,[1] in the Kirghise steppe, round the Gobi desert, etc. We may therefore assume the very ancient dry area of Central Asia to have been the cradle of the first 'Reed-Warblers' whence they spread in various directions, founding isolated colonies of reed-haunting species.

If one wants to date the origin of the group of Great Reed-Warblers, the following considerations may be of some help.

The dispersal of the Indonesian branch of *A. stentoreus,* from the Philippines down to Australia and New Guinea, must have taken place during Pleistocene times (exactly like that of *Cisticola exilis, Tyto longimembris, Turnix sylvatica,* etc.). The time elapsed since Australia was reached by *Acrocephalus* has been long enough for allowing an increase in body size from north to south which follows 'Bergmann's rule' (Mayr 1948).

If we assume that *Acrocephalus* settled in Australia during late Pleistocene we are forced to the conclusion that *A. stentoreus* had already emigrated from the Continent to Indonesia (the Philippines) in early Pleistocene, for the Indonesian branch is far more differentiated from the continental one than the South Australian populations are from the North Australian ones. On the other hand, the morphological distance between *A. arundinaceus* and *A. stentoreus* seems to be still greater than the distance separating the tips of the two main branches of *A. stentoreus.* This being true the bifurcation of the genealogical tree into a *stentoreus*-branch and an *arundinaceus*-branch must have taken place in late Tertiary times already, and its splitting-up into those branches which gave rise to several now widely distinct species (like *arundinaceus, scirpaceus, baeticatus, agricola*) at an even earlier period. (see fig. 5).

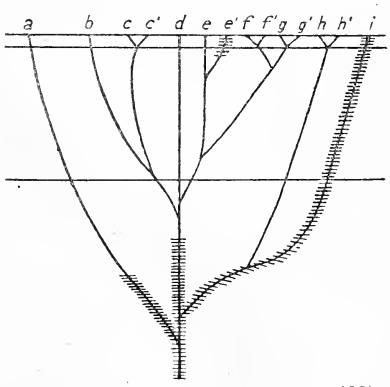


Fig. 5 (explanation on p. 439)

Calculations like this one are, however, rather inaccurate, in as much as the rate of differentiation may be largely influenced by the size of the population, being highest in very small ones.

Distribution

The ranges of the present forms of Great Reed-Warblers are restricted by bound-

[1] In this region a second genus of birds, *Remiz,* consisting of tree- and bush-haunting species, has been increased by the development of a specialized reed-dweller: *Remiz macronyx.*

aries which mostly seem to be set by ecological factors and may therefore be regarded as more or less stable. In northwestern Europe, however (and probably at other places too), matters are

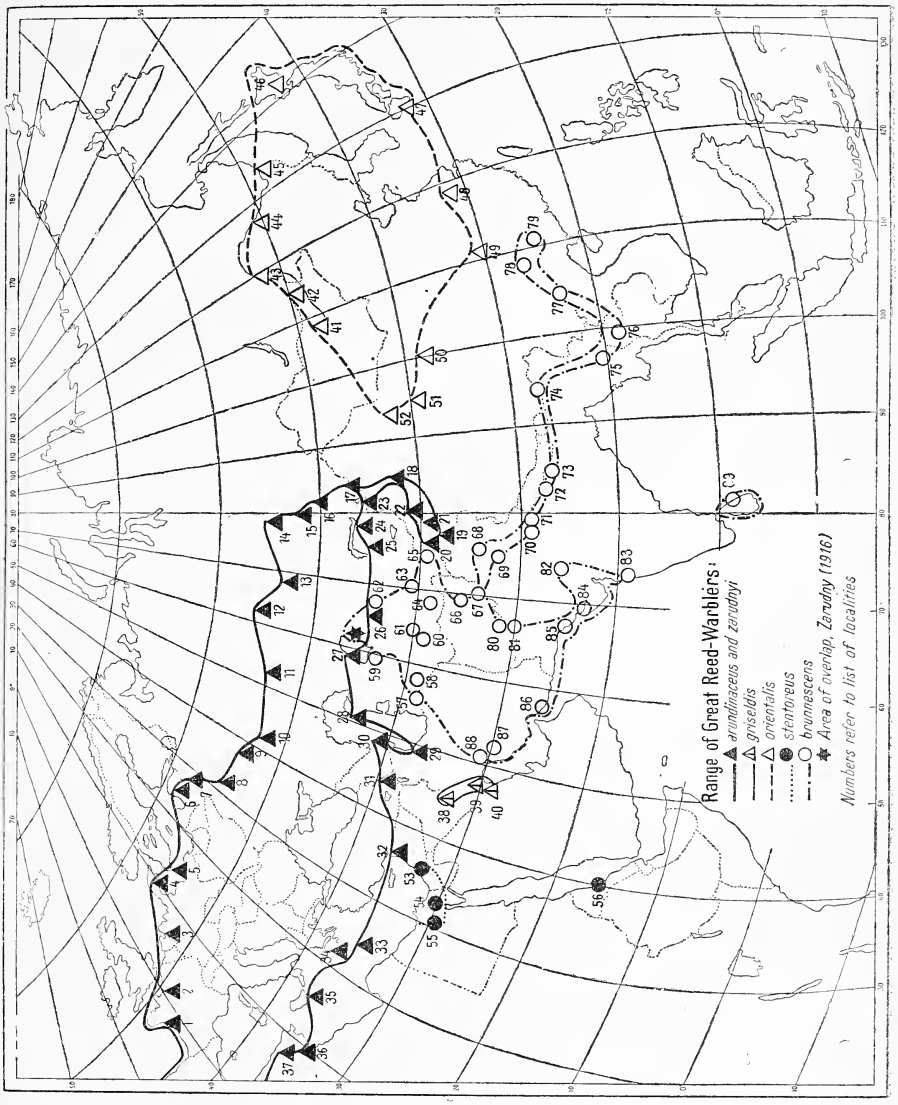


FIG. 6 (numbers refer to list of localities)

different. *A. arundinaceus arundinaceus* proves, by still expanding its range to the northwest, to be a late immigrant to that area. This bird has failed to reach England, where *A. scirpaceus* is of common occurrence in the reed belts. The Cimbric peninsula and the Danish islands have been settled by Great Reed-Warblers after 1850 only, and southernmost Sweden not before the present century.

Our map of distribution (Fig. 6) shows the fact that at several places the range of two forms, though approaching each other rather closely, are still separated by an area not inhabited by any of them. *A. arundinaceus zarudnyi* and *A. stentoreus brunnescens* are prevented from meeting each other by ecological barriers (the high Tianshan range and, at other places, deserts), except for the borders of Lake Aral, which could easily be reached by the former from the north, and by the latter from the south (via the course of Amu Darya). We failed to find any record of Great Reed-Warblers breeding in the vast reed belts at the S.W. corner of the Caspian Sea; one would not be surprised by the discovery in that region of two forms, *A. arundinaceus arundinaceus* and *A. stentoreus brunnescens*. Other crucial spots of the map are firstly the swampy country round Lob-nor, where *A. arundinaceus zarudnyi* as well as *A. orientalis* may have met already, without hitherto having been collected, and secondly the region bordering the Persian Gulf between Fao and Bushir, which possibly has been settled already by either *A. stentoreus brunnescens* or *A. (arundinaceus) griseldis,* or even by both.

Remarks Concerning the Map of Distribution

The authors have refrained from using different symbols for *A. arundinaceus arundinaceus* and *A. arundinaceus zarudnyi*. Both these subspecies differ to a very slight degree only and apparently intergrade in a large belt. It seems probable that the range of *A. arundinaceus arundinaceus* extends across northern Asia Minor and Transcaucasia to the Bay of Enzeli, while *A. arundinaceus zarudnyi* inhabits the region between southwestern Siberia and Lake Aral. This assumption, differing from Salomonsen's (1929), needs being tested with the help of adequate material.

The populations of *A. stentoreus* breeding in Southern China (Yunnan, Kwangsi, Kwangtung) have been united with the subspecies *brunnescens* only provisionally. Comparison may prove them to be subspecifically different.

Summary

The small group formed by the Great Reed-Warblers proved to be well-suited for the study of speciation problems.

Since 1929 all Great Reed-Warblers have generally been considered to belong to the same species, called *Acrocephalus arundinaceus*. This view cannot be maintained because of the coexistence of two non-hybridizing forms (*brunnescens* and *zarudnyi*) along the eastern border of Lake Aral and the Lower Amu Darya.

At least two species, *A. arundinaceus* and *A. stentoreus,* will have to be accepted. The authors decided to propose even a third species, *A. orientalis,* which forms the link between the two others, while the form *griseldis* has been (provisionally) attached by them to the species *A. arundinaceus* and the Indonesian group of races to the species *A. stentoreus*.

The chief morphological differences of the various species are to be found in the wing formula and the emargination of the distal

primaries, differences for which a functional explanation is offered on p. 431.

Migration, moult, ecology, history of dispersal and present distribution are briefly discussed.

The Great Reed-Warblers seem to be descendants of bush-haunting birds (related to *Hippolais*) which, forced by ecological pressure, specialized for a life in reed belts. This shift of habit may have taken place during Tertiary times on the outskirts of Central Asiatic deserts. That this may be a reversible process is suggested by *A. stentoreus stentoreus* and *A. stentoreus brunnescens*, certain populations of which have settled in mangroves (*Avicennia*), thus reassuming what may be considered the habit of a very remote ancestry.

Explanation of Figures

1. *a*. The wrong conception: three races forming one single species.
   b. The facts and the problem: two or three different species?
2. Difference in shape of wing between (2 A) *Acroceph. a. arundinaceus* (solid line) and *Acroceph. s. brunnescens* (dotted line) and between (2 B) *Acroceph. orientalis* (solid line) and *Acroceph. s. brunnescens* (dotted line).
3. Differences of emargation between *Acroceph. a. arundinaceus* (above) and *Acroceph. s. brunnescens* (below).
4. Map of Summer and Winter Range.
   ———— *Acroceph. a. arundinaceus* + *zarudnyi* + *griseldis.*
   — — — — *Acroceph. orientalis.*
   —.—.—.— *Acroceph. s. brunnescens.*
   ... ... *Acroceph. s. stentoreus.*
   Winter Range shaded.
5. Phylogeny of Reed-Warblers.
   a baeticatus
   b griseldis
   c arundinaceus arundinaceus
   c a. zarudnyi
   d orientalis
   e s. brunnescens
   e s. stentoreus
   f-g Indonesian forms
   h scirpaceus
   i palustris
   H = Holocene
   Pl = Pleistocene
   T = Tertiary
   bush haunting
   ———— reed haunting
6. Map of distribution. (Numbers refer to list of localities.)

List of Localities

A. a. arundinaceus + *zarudnyi.*

1. Lower Loire, Olphe-Galliard (1891).
2. Lower Seine, Olphe-Galliard (1891).
3. Holland, ten Kate (1937).
4. North Jutland. Skovgaard (1932).
5. Iddingen in Shonen, Hermanson (1943).
6. Esthonia: Nuckoe Isle, Matzahl-Wieck, O. Koch (1911).
7. Distr. Pskov, Dementiev (1935).

8. ,, Smolensk, Pleske (1891).
9. ,, Tula, ,, ,, .
10. ,, Tambov, ,, ,, .
11. Bugurusslan, ,, ,, .
12. Shadrinsk, ,, ,, .
13. Kokchetav, Dementiev (1935).
14. Kainsk, Sushkin (1938).
15. Lake Kulunda, Johansen (1904).
16. Tarbagatai, Dementiev (1935).
17. Saissan-Nor, Pleske (1891).
18. Juldus and Tarim valley. Pleske (1891).
19. Yarkand, Hellmayr (1929).
20. Kashgar, Ludlow and Kinnear (1933).
21. Maralbashi, Hellmayr (1929).
22. Aksu, Hellmayr (1929).
23. Ala-Kul, Brehm (1882).
24. Lepsa-Mouth, Nikolski (1883).
25. Ili valley, Nikolski (1883).
26. Distr. Perovsk, Dementiev (1935).
27. Tshe-Bash, Sarudny (1916).
28. Ft. Alexandrovsk, Pleske (1891).
29. Enseli, Buxton (1921).
29 a. Resht, Witherby (1910).
30. Lenkoran, Radde (1884).
31. Aralych (Ararat), Sushkin (1914).
32. Lake of Antioch, Meinertzhagen (1935).
33. Crete, Stresemann (1943).
34. Peloponnesus, Niethammer (1943).
35. Lentini-Lake, Stresemann (1943).
36. Oud-el-Hatob, Withacker (1905).
37. Fetzara-Lake, Loche (1867).

A. a. griseldis.

38. Lake Akkarkuf (near Bagdad), Ticehurst (1922).
39. Gurmut Ali, Medina-marshes, Ticehurst (1926).
40. Fao distr., Bubian, Ticehurst (1926).

A. orientalis.

41. Tola valley, Kozlov (1933).
42. Tarei-Nor, Onon river, Stegmann (1929).
43. Argun river, Pleske (1891).
44. Seja, Stegmann (1931).
45. Ussuri, Stegmann (1931).
46. Hokkaido, Jahn (1942).
47. Kiushu, Jahn (1942).
48. Lower Yang-tse-kiang, La Touche (1925).
49. Shasi near Ichang, La Touche (1922).
50. Kantshu, Stresemann, Meise, Schoenwetter (1937).
51. Ssatsu, Pleske (1889).
52. Oasis Chami, Pleske (1889).

A. s. stentoreus.

53. Lake Huleh, Meinertzhagen (1930).
54. Near Suez, Meinertzhagen (1930).
55. Fayum and Wadi Natrum, Meinertzhagen (1930).
56. Massaua, Heuglin (1869).

A. s. brunnescens.

57. Achal-plain and Atrek-river. Sarudny (1896).
58. Geok-Tepe, Sarudny (1896).
59. Amu Darya, Moltchanov (1912).

60. Merv, Sarudny (1896).
61. Chardjui, Sarudny (1896).
62. Karatau-Mts., Dementiev (1935).
63. Leninabad, Ivanov (1940).
64. Hissar, Ivanov (1940).
65. Daraut-Kurgan, Ivanov (1940).
a. Goultcha, Stolzmann (1896).
66. Bamian, Whistler (1945).
67. Kabul, Whistler (1945).
68. Srinuggar, Oates (1889).
69. Gurdaspur, Currie (1916).
70. Delhi, Whistler (1931).
71. Moradabad, Whistler (1931).
72. Bahraich Distr., Whymper (1907).
73. Gorakhpur, Osmaston (1913).
74. North Lakhimpur, Stevens (1914).
75. Taunggyi, Wickham (1929).
76. Chiang Mai Plain, Deignan (1945).
77. Mongtze, Uchida and Kuroda (1916).
78. Too-Yuen (Kwei-chow), Yen (1934).
79. Yao-shan (Kwangsi), Yen (1930).
80. Kandahar, Ticehurst (1926).
81. Quetta, Ticehurst (1926).
82. Pali (Jehol), Whistler (1938).
83. Bombay, Sálim Ali (1937).
84. Eastern Nara, Oates (1889).
85. Karachi, Ticehurst (1922).
86. Jask, Ticehurst (1926).
87. Shiraz, Blanford (1876).
88. Zagross Mountains, Witherby (1903).
89. Ceylon, Whistler (1944).

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BOMBAY FISHERMEN'S INGENUITY.

AGE OLD METHODS OF CAPTURE NOT YET OUTDATED

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(*With* 1 *plate and* 5 *text figures*)

A charge generally levelled against fishing in our country is the primitiveness of the methods employed in its pursuit. The main target of criticism is the comparative inefficiency of the nets used, as well as the manner in which they are employed. The charge is, to a great extent, baseless as will be readily apparent from even a superficial study of the nets used along our coast. The nets have been evolved after a long process of trial and error, so as to secure the maximum catch for the outlay of the considerable amount of labour employed.

Adepts in Craft

Fishermen are generally supposed to be ignorant. Their ignorance is relative, inasmuch as it may pertain to a lack of knowledge of the work-a-day world. Their complete proficiency in matters affecting their own industry is unquestioned. Their knowledge in this respect is truly amazing. It might not be grounded on scientific principles, but it is extremely efficient and discloses an intimate acquaintance with the fundamental concepts of biology, physics, state of the weather and movements of the tides. Their knowledge of these highly technical subjects is empirical, but it is, nevertheless, sound, as all the various methods of fishing practised on our coast—pelagic and deep-sea—incorporate awareness of one or the other of the fundamental principles which form the bases of these highly developed fields of study.

The results achieved by our fishermen are truly remarkable, notwithstanding the numerous handicaps under which they labour. They would certainly show results worthy of comparison with those achieved in the West or in Japan only if their economic resources permitted the use of engined craft. They have shown endless ingenuity in their ability to devise various types of nets for the capture of fish of different sizes and inhabiting varying layers of the sea. The fishermen, it is commonly said, are conservative, but their conservativeness springs from their penury. There is not the least doubt that if power-propelled vessels were placed within their reach, they would be able to adapt their existing types of nets to the capture of the various fish that occur in divergent layers of the seas washing our coasts.

Lessons of Recent Years

The success that has attended the use of launches for the transport of fish in Bombay has furnished conclusive proof that our fishermen are not averse to the adoption of new ideas provided that the reforms are both beneficial and within their reach. The formation of fishermen's co-operative societies for the acquisition of launches to transport fish shows that they are capable of following progressive principles. The imagination of our fishermen has been caught not only by the advantages of power craft for the transport of fish but they have also been greatly impressed by the satisfactory results that have accompanied the experiments to use power craft for the capture of fish. There is a vast and promising future before the industry, but all depends on our approach to the various problems.

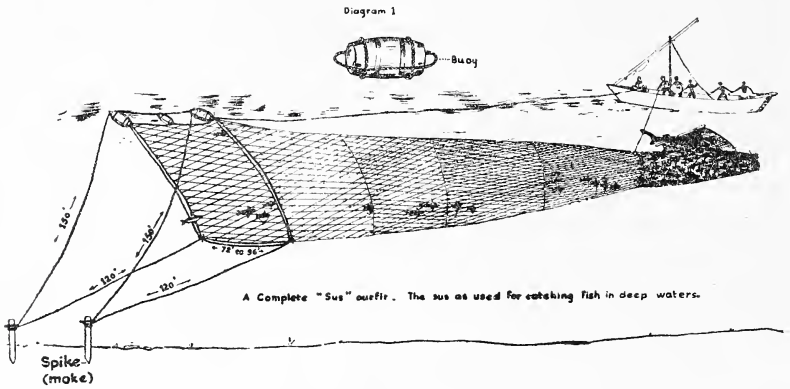
Importation of trawlers, purse seiners and Danish seines is excellent as far as it goes, but they will need, apart from expert technical skill, vast outlay of capital, which our fishermen can ill afford in their present impoverished state. They will go in, in the fullness of time, for these super-vessels of the industry. The paramount problem today is mechanization of the existing sailing craft. The pace of their conversion into power-propelled vessels should be greatly accelerated if the industry must progress and yield the fruitful results of which it already holds enormous promise.

Line of Advance

The first step would be to assess thoroughly the various advantages and disadvantages of the existing methods of capture and discover whether improvements are not possible in the different types of fishing—drift-net, long line, bag net (dol) etc.—now extensively used along one stretch or another of our extensive coastline. Thus, the principle underlying the use of drift-net, whether in Britain or in India, is the same. There are, however, differences in the length and depth of the net. The use of larger drift-nets is possible only on larger vessels if they are equipped with power and other mechanical devices for the rapid paving and hauling of the net. If our vessels using the drift-net were run on power, they would, most certainly, be able to extend the range of their operation. At present, they cannot venture very far out to sea and have to skirt, as it were, the coastline, so that they can make for shore as quickly as possible at the least sign of bad weather or to prevent deterioration of their catch.

Drift-netting:—Though the drift-net is one of the most effective contrivances for the capture of fish, it is nevertheless, subject to certain limitations. Tropical seas, as is wellknown, abound with sharks, They are an ever-present menace to our fishermen, who fear them not so much for themselves as for the extensive depredations they make on their catch. The fish gilled in the drift-net present sharks with a tempting and immovable target on which they eagerly pounce. The fishermen are sorely stricken when the sharks, in getting at their quarry tear vast rents and sometimes, even swallow big segments of their

nets. For some time then the fishermen are jobless at their craft, until they have repaired their net. Thus, the everlurking menace of sharks is a factor compelling restriction on the size of the net. It must, therefore, be handy in size,—the netting being 2000 fathoms in length and 2 fathoms in depth—so that not only can it be quickly manipulated but also the netted fish can be pulled aboard in anticipation of the attacks from sharks. In fact, fishermen at the fishing fields almost throughout the night row up and down the length of the net pulling it up and stowing away the netted fish and again dropping it in order to avoid presenting sitting targets for sharks and thus to save their nets from the vicious destruction caused by them.

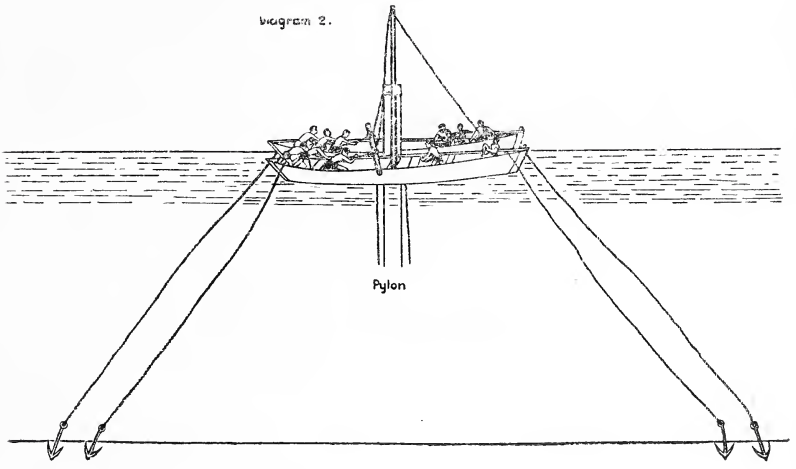


Fishermen in the temperate zones are, on the other hand, spared such perils, for the simple reason that sharks are not usually denizens of their waters. Nets are shot at dusk and hauling begins shortly before dawn. The net is paved at right angles to the incoming or outgoing current, so that it hangs in the water about a fathom below the surface, and is kept in position by floats. A British drifter will shoot anything up to 100 nets, each net being about 60 yards long by 10 yards deep. Thus a wall of netting about two miles in length is laid by the drifter. The fish moving with the tide get enmeshed. The un-anchored vessel, to which the net is attached at one end, drifts a while, may be for five or six miles in the night, according to the current. At dawn the fishermen merely gather up the net and hie with it to port.

The implied line of reform is obvious, so far as fishing with drift nets in our waters is concerned. The menace of sharks may be, to a great extent, overcome if not entirely eliminated, if our fishermen were to employ, instead of sail boats as now, powered craft to gain the fishing grounds and pave out the net. The great waste of human effort now involved by reason of constant trips up and down the length of the net by a dinghy, may be obviated if a powdered skiff were used as an adjunct to the parent vessel instead of the row boat as at present. This

could cruise up and down the length of the net throughout the night in order to collect the gilled fish, as well as to stave off the depredations of sharks.

Line fishing :—Line fishing is another method of capture which holds promise of fruitful results. Already our fishermen practise line fishing extensively all along the coast for particular varieties of fish, but their efforts are not attended by striking success. Their unsatisfactory catches are due to limitations inherent in the type of vessel used. Their sailing boats do not enable them to go far out to sea, as the paramount consideration is quick return to shore. Moreover, the smallness of their craft precludes the use of a large enough number of hooks. These obvious handicaps would be greatly minimised, if not surmounted, with the use of power-propelled vessels, the greatest advantage of which would be that they would be able to fish anywhere and make



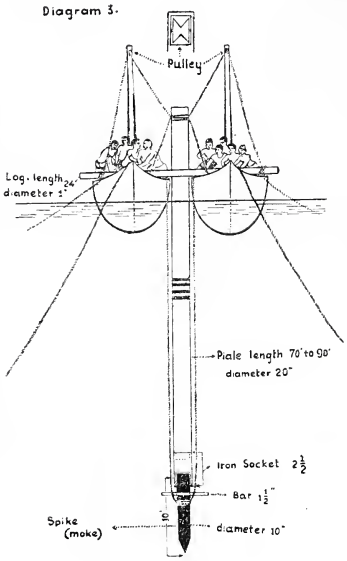
straightway, within a comparatively brief period, for the large consuming centres. This sailing boats are unable to do. They have first to get to their bases and then await expeditious transport, either by trucks or power vessels to convey their hauls. The vast potentialities for line fishing are borne out by the discovery about 100 miles off Ratnagiri of a great field of red snappers (perches) which can be taken on line and hooks. Preliminary surveys reveal that this particular field—Angria bank lying in latitude 16° 30′ N. and longitude 72° E.—is an extensive one and is capable of yielding fruitful results for the appropriate outlay. It is also the considered opinion of those who discovered the field that there must be equally rich fishing banks elsewhere along our coast, though there is no knowledge of them, because they have never been approached. Such fishing banks are utterly beyond the reach of our sailing boats. Even power-propelled vessels are reluctant to approach them individually on account of the legitimate fear of the unknown at so great a distance off-shore.

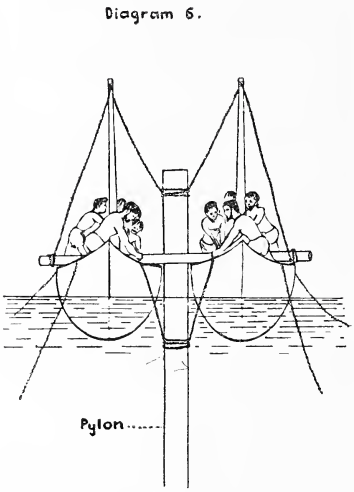
Successful working of such banks at so great a distance can be undertaken by our present power-propelled vessels only if they work in teams, or if they have the confidence that if any one of them sallies forth individually to the bank there is the assurance that other vessels will also be expected to operate in the same region.

The use of power vessels to capture sharks has been amply demonstrated in our waters, and our efforts show that there is a great future for this particular industry.

Japan's Example

Japan's example shows that mechanization of the fishing fleet can be rapidly achieved provided there is not only the proper spirit of enterprise but a determination and willingness to disregard age-





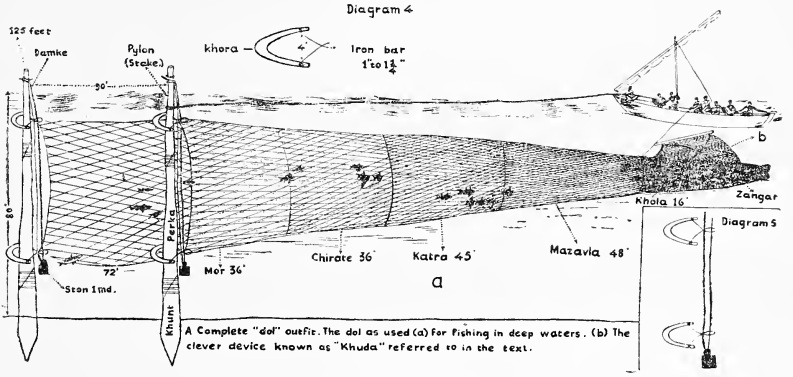
old methods in favour of those that will yield better results. What our fishermen need is that a lead must be given to them. Pilot experiments with existing nets used, not from sailing boats as at present, but from power vessels, must be undertaken on an intensive scale at the more important fishing centres along India's coastline. The length of nets that may be used from power-propelled vessels is large, and there is not the least doubt that our fishermen will be resourceful enough to exhibit their traditional ingenuity in the skilful adaptation of their present devices to the altered environment of engined craft.

One example alone will suffice to illustrate not only the originality but also the power of adaptation of our fishermen to suit the peculiar conditions of their industry. Perhaps, this remarkable gift and instinctive genius of our fishermen may well be proved by a

description of the 'dole' net, which is extensively used by them 20 miles off the shore, with the coastline completely invisible.

Description of net:—The 'dole' is conical in shape, the base, which is the open end, being rectangular. The length of the net from the rim of the base to the tapering closed end is about 150 feet, with a circumference at the mouth varying from 180 to 265 feet. Although the net resembles a huge trawl, it, nevertheless, differs from it in being stationary, and, unlike the trawl, it captures surface fish at a depth of a few fathoms.

Tidal energy exploited:—The net is worked entirely by the force of the tide. It is set in the water so as to face the incoming current. As the tide starts to recede, the position of the net is reversed, the open end facing the opposite direction. The object in both positions is propulsion of fish into the net by the force of the current.



The dole net is capable of being employed in two different fashions. The first method (Sus fishery) is employed from Kathiawar in the north to Revdanda in the south. The second method (Khunt fishery) is employed from Revdanda (the port for Alibag) to Versova.

The main characteristic of both the methods is the technique used to anchor the net and to keep its mouth open. The mouth of the net is kept in position by means of ropes from each of its four extremities, fastened securely to two enormous wooden spikes 'moke' embedded in the muddy floor of the sea. The upper lip of the net is prevented from sagging by means of three floats, two of which are at the extremity of the lip, and one is in the centre. The lower lip of the net hangs freely, the pressure of the rushing current and the two bottom ropes keeping the mouth wide open. The position of the net when it is fully set is illustrated in diagram I.

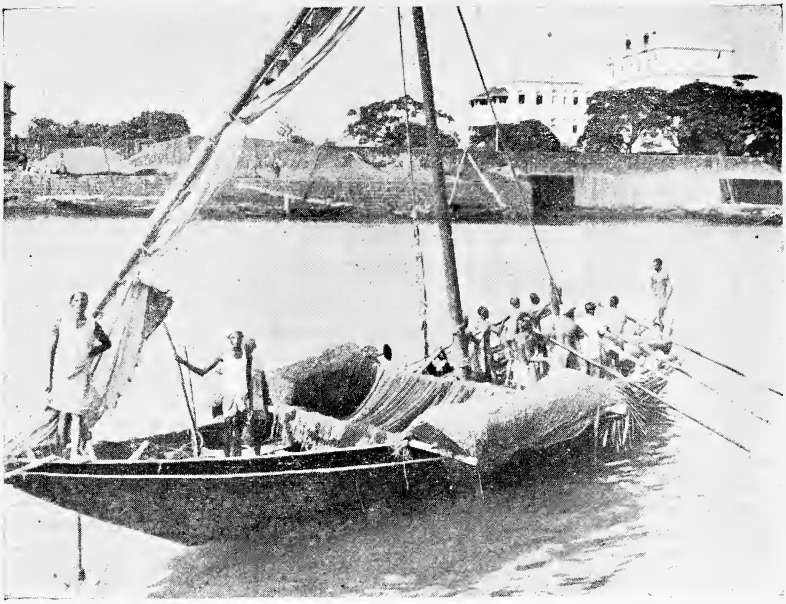
Pile driving at sea:—The spike itself is driven into the floor of the sea by an ingenious method. The spike is, in reality, detachable part of a lengthy stake, the lower end of which has an iron socket into which the upper end of the spike fits firmly. The ever present risk of irretrievable loss of the spikes when the stake

is being lowered is prevented by two ropes tied to the spike below the iron rod inserted laterally across each spike.

The operation (diagram 2) involves at low tide the use of two boats, which on their arrival at the fishing field cast four anchors, two ahead and two astern. The two boats are then linked to each other by means of a log across, which is made fast by means of ropes tied to the broadest cross beam in each vessel. The most important phase of the entire operation now begins. The upper end of the spike is inserted into the iron socket of the 'Pyale' or stake (diagram 3), which is levered to the centre of the log. The upper end of the 'Pyale' is connected by a rope to a pulley arrangement at the mast head of the two vessels. The 'Pyale' is raised till it is upright when it is lowered into the sea. A stout rope is looped round the upper part of the 'Pyale', and each end of the rope drawn under the log is taken into either vessel. The boats are manned by a crew of seven in each. The rise and fall in the level of the water acts as a powerful hammer to drive the pile into the sea-bed. The two ends of the rope have a certain amount of slack which as the boat rides on the crest of a wave is absorbed by the men pulling it as taut as possible. This tautness, coupled with the fall of the vessels into the trough of the waters, exerts a powerful downward thrust on the spike which automatically drives the spike down deeper and deeper. The process of the surge and recession of the waves eventually thrusts the spike to the required depth in the sea floor. The ropes from the mast head to the lateral log linking the two vessels serve to maintain tension which keeps the stake upright and prevents its drifting.

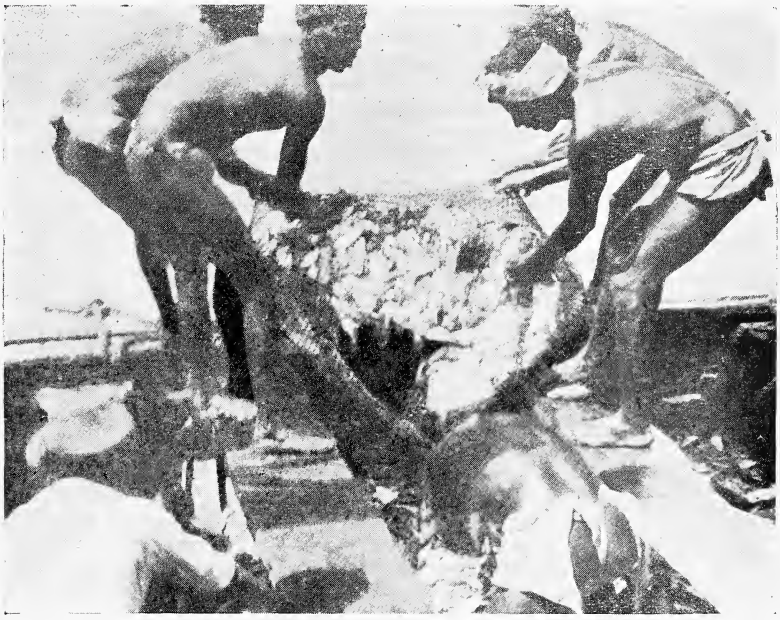
The 'Pyale', which has all the while served, as it were, as a pile driver to ram the spike into the sea floor, is then effortlessly detached and levered up from the base of the spike, which all the while had been held in position by the pull exerted on the ropes tied to the spikes below the iron rod inserted laterally across the spike, as already referred to above. The loose ends of both ropes are fastened to a float. The float serves roughly as an indication enabling the fishermen to determine the distance at which the second spike must be driven in. Anchors are cast, in order to render the boats immovable at their station, and once more the whole process of driving the spike is repeated at this new location. The distance between the two spikes is 150 feet. The top ends of the ropes, two from each spike, are tied to the four extremities of the mouth of the net, so that it remains open. The loose ends of the ropes from each spike are secured to buoys after the net has been hauled aboard for repairs or for dyeing. The buoys serve as indicators to the location of the spikes, so that no time is lost when the fishermen desire to set the net.

Pylons in the sea:—The net is also set by another method, which differs but slightly from the one just described. The second method is known as 'khunt' fishery (diagram 4). The difference between the two methods lies in the manner of fixation of the net. Whereas buoys and ropes are employed, in the first instance to keep the mouth open, stout pylons (palisades or upright posts), each about 125 feet in length are used for setting the net in the second method.



Drift net Fishing

Many types of sailing craft, all of them primitive, are used along our coast to catch fish. The vessel in the picture is used for fishing in deep waters. Though primitive, the boat uses a drift-net, one of the most modern fishing nets for the capture of surface fish. The department is now endeavouring to induce fishermen to use these very nets in conjunction with power vessels.



The bag end of a 'dole' net crammed with Bombay Duck is seen here being hauled aboard a row-boat at the fishing fields, about 20 miles off the shore of one of Bombay's suburbs.

Each pylon consists of usually three, sometimes four, enormous trunks of trees, khunt 60 feet, parka 45 feet, damke 35 feet, bound one to another by ligatures. The pylon is driven about 24 feet into the sea floor while it projects about 10 feet above the surface of the water at the highest tide. Each pylon costs Rs. 1,000.

The method of fixation of the pylon is almost identical to that of the insertion of the spike into the sea in the first method. The 'Pyale' of the first method is replaced by the pylons or upright posts, which are towed to the fishing fields by a boat apiece. Each pylon is driven separately. The same principle of pressure exerted by the rise and fall of the waves is observed in order to pound the pylon into position (diagram 2).

To each of the pylons is fixed a peculiar contraption known as the 'khora', a part of which is of wood and the other of iron. The wooden part is a U-shaped contrivance, resembling very much the wooden part of a bow when fully drawn. The intervening space between the two tips is 4 to 6 feet. Round one tip is wound an iron rod, which is looped, the loose end being wound round the other extremity. Two of these contraptions are slung over each pylon, a rope of the depth of the mouth linking the two iron bars at their junctions. Through the loops themselves is passed another length of rope to the lower end of which is suspended a weight or a large stone weighing about a maund (diagram 5). The upper end of the rope is wound round the part of the pylon projecting above the surface of the water. Likewise, two other U-shaped contraptions of wood with iron loops are passed over the other pylon, together with a rope weighted at one end being passed through the loops. The pylon and the U-shaped wooden pieces form as it were the foundation on which the net is laid when it is to be in operation. Each end of the lower lip of the net is fastened to each of the bottom loops, likewise each end of the upper lip is attached to each of the top loops. The net is now ready to be slid down into position. The mouth of the net can be raised and lowered along the pylons according to the movements of fish. The mouth itself is also capable of contraction by a reduction in the length of the ropes linking each set of loops. The object of contraction of the mouth is to narrow the area of resistance when the stress of the tide is excessive. Generations of experience have made the fishermen such adepts that they are able to sense almost instinctively the precise occasion when the mouth of the net must be contracted. The precaution is essential in view of the costliness of the net and the immense labour involved in the manufacture of one. If such a net is seriously damaged the fishermen are likely to be out of the fishing fields for a considerable time, with consequent great loss in their earnings.

Upward leverage:—The method of extraction of the pylons at the end of the fishing season is no less ingenious than the technique followed in their fixation in the sea. The boats come to their stations equipped in the same manner with pulleys and logs as they did at the start of the season. The boats are arranged as in diagram 6 and recourse is had once more to the power or force generated by the rise and fall of the waves. The energy of the restless

motion of the waters is now used to lever out, instead of levering into, the stakes from their sockets in the sea bed. With the arrival of the boats at their station, a loop is thrown round the pylon, each loose end being gathered into each boat respectively. The loop is lowered to a certain depth when it is made tort by upward pulls on the loose ends. The tautness is increased every time the boats sink in the trough of the waves, the resultant tension acting as a sort of jack to prise the pylon out from the sea floor where it lies embedded. This process, which usually lasts about 3 hours continues until the entire pylon is pulled clear out of the sea bed. Likewise, the spikes are extracted from the sea bed. Their position is known because of the buoys to which they are fastened by ropes.

Construction of net:—No less ingenious than the method of fixation of the net (dole) is the construction of the net itself. The net measures 150 feet in length when it is fully extended. The size of the mesh diminishes as the net tapers to its extremity so that towards the rear it is almost a completely impenetrable bag. The net consists of a number of segments, each bearing its distinctive name, and each formed from twine of varying ply.

A feature of the net is its bag end which can be hauled up and the trapped fish can be stowed away on deck, while the main mouth is wide agape. The fish are channelled into the tapering end, the opening there being closed with a rope knotted round it. The rope is long enough to enable the log to rest on the sea floor. The fishermen are present on the ground during the fishing operations and usually take a location in proximity to the bag end. To protect the boat being swept away from its locale a rope is tied from the bow of the boat to one of the fixed side buoys.

Both the aforesaid methods have been practised for generations. They reveal, as already stated, not only extraordinary ingenuity but also a thorough knowledge of the movements of the fishes when they approach our shores. The technique employed in both methods is particularly noteworthy. The most remarkable feature of the entire operation is not only the great economy of man-power employed but the fishermen's realisation and application of the principle of gravity, to pile into the floor of the sea a stake without the use of such modern appliances as winches and cranes. The untutored fishermen, ignorant of all knowledge of theories of physics, have been practising this effective method for unnumbered generations.

The empirical method, based on no other knowledge than that derived from experience, has been accompanied by such striking success that it has emboldened the fishermen to increase steadily the radius of operation from the shore. They have ventured so far afield into the sea that the fixed pylons are a real obstacle in the fairway through which ships regularly ply. In fact, the menace of these obstructions has assumed such proportions as to have compelled the authorities to draw up charts indicating the precise positions in the sea where the pylons may be fixed.

The net is not selective but multi-purpose inasmuch as it does not discriminate among the fish which it is intended to trap. The

haul of such nets includes fish so diverse as:—*Harpodon nehereus* (bombil); *Stromateus cinereus* (serga); *Trichiurus savala* (wakati); *Trichiurus haumela* (wagti); *Sciaena sina* and *Sciaena diacanthus* (ghol); *Coilia dussumieri* (mandeli); *Sciaenoides pama* (kala droma); *Minous monodactylus* (dhoma); *Chirocentrus dorab* (karli, dantal); *Culpea fimbriata* (pedwa); *Ambassis sp.* (kepta); shrimps, prawns, crabs, sharks, skates and rays.

Superimposed net:—Even more ingenious than the net itself and the manner of its laying is the clever device (known in Marathi as the khuda) to foil onslaughts by sharks and other predatory fish on the ready target afforded by the silvery sheen of the fish secured in the bag ends. The device, which looks very much like an open skylight (diagrams 1 and 4), consists of a subsidiary oval bag net tied to the bag end. Predatory fish get entangled there. A light pole at the upper edge of the subsidiary net ensures that it remains open.

The catches made by the 'dole' represent, perhaps, the preponderant value of the total haul of all other types of nets put together. Monetarily, the total quantity of fish caught by this method is estimated at over a crore of rupees.

NOTES ON THE SNAKES AND MAMMALS OF THE HIGH WAVY MOUNTAINS, MADURA DISTRICT, S. INDIA

BY

ANGUS F. HUTTON

PART I—SNAKES

(With a text-figure)

The High Wavy Mountains are situated in the S. W. corner of Madura District on the Travancore frontier. They consist of an undulating plateau, approximately 17 sq. miles in area, with an average elevation of 5,100 ft. though the highest point (Brooks Peak) is over 6,400 ft. high.

The plateau is covered with dense evergreen forest, with the exception of a grass covered ridge overlooking the plains. There are quite a number of rocky patches in the jungle which are covered with grass, and the borders consist of hill-bamboo (*Ochlandra travancorica*) or *Eeta* as it is known locally. It is also found along the river banks and on the windswept ridges. A small area is under tea, cinchona and cardamon cultivation. The slopes of the mountain rise very steeply from the plains and can be divided into two belts; the first (1,200′–3,000′) consists of light deciduous forest with a dense growth of elephant grass and the whole area contains huge scattered rocks and boulders. The second belt is of bare rocky grassland, devoid of trees, but with considerable patches of *Strobilanthes kunthianus*. This belt continues up to 4,000′ where the evergreen forest begins.

With the exception of the B.N.H. Society's expedition in 1917, (described in the *Journal*, Vol. 25, No. 2; Vol. 27, No. 3; and Vol. 35, No. 3) these hills were entirely unexplored and uninhabited until 1929, and even since then only a small area was really known. In view of this it is not surprising that there should be some interesting records.

These notes are written with reference to 'The Fauna of British India', Vol. 3 (Reptiles and Amphibians), by Dr. Malcolm A. Smith, and I have followed the order used by him.

Family: UROPELTIDAE

Melanophidium punctatum. (Tamil: Manalli Pambu.)

One specimen taken in the evergreen forest. Apparently not common. In life it is a beautiful snake. At the time of writing, I have one in captivity, which spends most of the day curled up asleep in its drinking water, and only comes out at night.

Melanophidium sp.? Three specimens were found altogether. The first was very badly damaged, dried and quite useless for identification purposes, and was discarded. The second was a perfect specimen and was sent to Bombay for identification but unfortunately it got lost in the post. Luckily I kept a rough

description with me and this agreed exactly with my third specimen—a skin which was sent to me, and which I have sent on to Dr. Malcolm Smith. The description below is fairly accurate, and will suffice until further specimens can be found.

Snout obtuse; rostral small; internasals slightly larger than adjacent scales; parietal shields twice as long as broad; frontal shield touching the top of the eye. The eye within the ocular shield. No supraocular or temporal shield. A mental groove. Tail slightly compressed; terminal scute with two superior ridges ending in two small points.

Scales in 15 rows, the 3 dorsal rows faintly keeled. Laterals smooth. Ventrals 131 four times as broad as adjacent scales. Caudals 26, divided and decreasing in size towards the end of the tail. Anal shield divided.

Colour: iridescent brown above and below, with a black or dark stripe down the back covering the three rows of keeled scales.

Length: head and body 225 mm.; tail 37 mm.

Plectrurus perroteti.

One specimen taken in the evergreen forest. Not very common. Total length 370 mm.

Uropeltis ellioti. 5 specimens were collected in the evergreen forest, where it is fairly common. It seems to prefer damp localities, such as swamps and river banks. One female in captivity produced 4 young. The markings on the belly of the newly-born young are white and only change to yellow after a week or more. I have noticed this in *U. pulneyensis* also. Total length, average 210 mm. Young are 55 to 72 mm.

Uropeltis wood-masoni. Three specimens were taken in the evergreen forest; two were normal in colour and the other was much darker with the belly entirely black. Total length: average 231 mm.

Uropeltis arcticeps. One specimen taken on the plains at the foot of the hills at 1,200′ altitude. In scale counts it resembles *madurensis*. V 148 & C. 6, otherwise the description agrees with *arcticeps*. Total length 300 mm.

Uropeltis pulneyensis. This is the commonest snake in these hills; 53 specimens were examined, and I have had ample opportunity for studying its habits. The majority of my specimens were released after examination as they do useful work in the garden controlling pests such as cutworms, and certain insects, which from a few dissected specimens seem to be their main diet apart from worms. The majority of my specimens were caught on the roads, and in the tea nurseries during the early part of the S. W. Monsoon. Young ones are frequently seen at this time also. It may be due to their burrows being flooded out that forces them above ground. Decayed fallen trees, stumps and heaps of stones are favourite homes for them during the rains, and I have often, found two or three sharing a hollow, and sometimes young ones, too. They were usually in a very lethargic condition which leads me to believe that they hibernate at this time of the year. With regard to their breeding habits I once found a pair in copula during May. I kept them in captivity and at the end of July the female produced 8 young. The markings on the belly were white and took 7 to 10 days to turn yellow. They averaged 60 mm. in total length at birth. The young have voracious appetites, and some of mine swallowed worms almost as big as themselves. One exceptionally large female measuring 450 mm. in length and 18 mm. in diameter produced 17 young in captivity. This seems to be most unusual both as regards size and numbers. (Smith, Fauna Brit. Ind., p. 64, '3 to 8 young at a time' and p. 85 'total length 380 mm. and diameter 12 mm.'). The average length of all my specimens was 237 mm.

Rhinophis sanguineus.

Three specimens were taken from the deciduous belt where it is fairly common. One juvenile measuring 150 mm. was also taken; the red on the underpart of its tail was not so bright as in the adult specimens.

Rhinophis travancoricus.

One specimen collected in the foothills at about 1500 ft. Does not appear to be common. Total length 150 mm.

Family: BOIDAE

Python molurus. (Tamil: Mallay Pambu.)

No specimens were taken but it seems to be fairly common up to about 5,500 ft. Some years ago, I am told, it often used to be seen in young tea clearings, in the evergreen forest. Prater, in a letter to me records meeting one in these hills in May 1917. Two local skins were examined and measured, one of 12 ft. and the other of 17 ft. in length, though the latter had been stretched in the curing. In the deciduous belt I once saw one on a rock, but it escaped before I could capture it.

Family: COLUBRINAE

Elaphe helena. (Tamil: Kattu Pambu.)

A common snake in the deciduous and rocky grassland belts. Seven specimens were taken. The largest was 1200 mm. in length and very dark in colour and had very few of the rings round it visible. Average length 670 mm.

Ptyas mucosus. (Tamil: Sara Pambu.)

Very common in all the belts. Those from the evergreen forest are considerably darker than the others. Fourteen specimens were taken, the largest 2475 mm. in length. The fat surrounding the intestines is used by the local people as a remedy for skin complaints; they apply the melted fat onto the affected parts. I am informed that unless the fat is removed immediately the snake is killed it loses its medicinal (?) properties and is useless!

Coluber fasciolatus.

Three specimens were taken in the deciduous forest belt, where they are fairly common. It is an aggressive snake and will make no attempt to escape, but it will stand its ground and bite readily with loud explosive hisses and this plus its habit of inflating its neck makes it closely resemble a cobra. In spite of its viciousness it is surprising how soon it becomes tame in captivity. One female I had laid 7 eggs and shed its skin at the same time during March.

Oligodon venustus.

Fairly common; five specimens were obtained in the evergreen forest and rocky grassland belt. Average length 362 mm.

Oligodon travancoricus.

Also fairly common in the evergreen forest, which it rarely leaves. It is more shy in its habits than the other snakes of this genus. Five specimens were taken, including two juveniles (in April); the latter measured 100 mm. and 120 mm. in length. Their bellies were white with black spots compared to the yellow of the adults. The adults averaged 387 mm. in length.

Oligodon taeniolatus.

A very common species preferring the higher elevations of the evergreen forest. It is very fond of basking in the sun on rocks or on grass. My dog caught two or three on the lawn when they were thus engaged. I captured a few in my garden where they lived in stone revetments. One female I tried to catch in April, retreated into a hole in the revetment just out of reach, and so I removed some stones to get at her, and disclosed a cavity, in which were 9 ova and the snake. On being picked up she bravely defended herself and her eggs, and inflicted several bites on my fingers. The sensation was one as if cut by a razor blade. In all eighteen specimens were taken, including a young one in May which measured 75 mm. The average length of the adults was 390 mm.

Oligodon brevicauda.

One specimen only was taken in the evergreen forest; the belly of it was more orange than red in colour, I think it must have recently shed its skin, as it had a beautiful sheen all over it. This probably explains the orange colour. It measured 393 mm. in length.

Lycodon travancoricus. (Tamil: Kattu Vyrian Pambu.)

Common in the evergeen forest near human habitations which it often enters. Four of my five specimens were caught in my bungalow at night. They seem to like a diet of cockroaches. Both the specimens I dissected contained their remains, also those of other insects. They do, therefore, a certain amount of good. Their average length was 420 mm.

Lycodon striatus.

Uncommon, only one specimen 185 mm. in length was taken in the deciduous belt at about 3,000′.

Dryocalamus nympha. (Tamil: Kattu Vyrian Pambu.)

Three specimens were caught in my bungalow at night. Fairly common. Their diet and habits are similar to the last genus. Average length 211 mm.

Natrix piscator melanzostus. (Tamil: Tanni Pambu.)

Two specimens were taken with a butterfly net whilst crossing a river. Two others which evaded capture were seen in a large waterhole where they were busy catching tadpoles. They were a joy to watch, they seemed so completely in their element in the water, they dived beneath the surface and would swim twenty yards or more before coming to the surface for breath. Under water they seem able to swim faster than they can on the surface. One specimen I dissected contained four tadpoles and two small fish 2″ in length. They seem fairly common in the evergreen forest. Average length 580 mm.

Natrix stolata.

Two specimens were taken in the deciduous belt where it is not uncommon near streams. One of my specimens was found when half-eaten by a cobra which I killed. The skin of this specimen, when stretched, disclosed a beautiful brick-red colour beneath the scales. Average length 607 mm.

Macropisthodon plumbicolor. (Tamil: Pacha Pambu.)

Fairly common in the deciduous belt near water. I never saw one above 4,000 ft. Four specimens were taken including a young one 100 mm. in length (in May). Average length 520 mm.

Atretium schistosum.

One specimen was taken in the deciduous belt. It does not appear to be common. My specimen did not exhibit the red stripe down the body in scale rows 5 and 6, which according to Wall (Fauna Brit. Ind., p. 320), specimens from S. India should have. Perhaps it was due to its size as it only measured 300 mm. in length.

Boiga ceylonensis. (Tamil: Komberi Mooken Pambu.)

This beautiful snake is very common in the evergreen forest and in the deciduous belt. Fifteen specimens were taken. The females in every case were smaller than the males, and were more orange than yellow in ground colour, especially about the neck. This colour of course disappears after the specimen is placed in spirit. Many of my specimens were found whilst sleeping in the pandals of tea nurseries. One was found in the bungalow at night on the picture rail; how it got there I cannot imagine. Picking this snake up by the tail to avoid being bitten (for it is very aggressive and bites readily) is quite useless, as it rapidly climbs up its own body and inflicts a painful bite on the hand that holds it. I found this out with one of my first specimens, a female, I had extracted from a hole in a tree, by its tail. After being bitten, I grabbed its

neck with the other hand whereupon it promptly laid 7 eggs in my hand! This incident occurred in April. If pursued in a brush or pandal it can travel amazingly quickly, and can jump out a good distance onto the ground. They are excellent climbers; I once saw the shed skin of one wedged into the bark of a tree over 15 feet up, its owner was a little lower down on a branch. Their main diet consists of frogs, tree lizards, and other snakes and insects of various kinds. They are also partial to small birds; one specimen I dissected contained the feathers of some bird it had eaten. Sometimes if handled by the neck it can eject a stream of evil-smelling fluid from the anus yellow and white in colour, which is most unpleasant, and the smell is difficult to get rid of. I have noticed this habit in some of the Uropeltidae also. Their average lengths were: males 970 mm and females 760 mm.

Dryophis dispar. (Tamil: Pachelli Pambu.)

Very common in the evergreen forest and in the deciduous belt. Thirteen specimens were taken. One found in March in a hollow log had just deposited 11 ova, which seems most unusual as this species is known to be viviparous. I can only put it down to a case of premature birth as the young were fully formed in the ova and were able to make good their escape when I cut the ova open. They measured 70 to 90 mm. The average length of the adults was 785 mm.

Dryophis perroteti.

Two specimens were taken in the deciduous belt. It does not appear to be common. One of my specimens was more olive-brown in colour than the usual green. One young one was also taken (in May) which measured 340 mm. The adults averaged 650 mm.

Dryophis pulverulentus. Uncommon. Only one specimen taken in the deciduous belt. The brown stripes on the sides of the head were very indistinct. Length 672 mm.

Callophis nigrescens.

One specimen was taken in the deciduous belt whilst shedding its skin on a rock. The new skin was bright scarlet though the unshed part was quite dull. It seems to be rare in this area as none of the local people had ever seen one before.

Naja naja naja. (Tamil: Nalla Pambu.)

Seven specimens were taken in the deciduous belt where it is fairly common up to 2,500 ft. One male specimen measuring 7'6" in length (2,250 mm.) was one of the so-called Black Cobras which are rather rare in the South. The spectacle markings were hardly visible; the lower part of the hood being jet-black. The lower jaw and underneath the hood was yellowish, and changed into one narrow and two broad black bars with brown in between, about 9" from the head. The tail was jet black above and lighter below. On being examined, the fangs were found to be missing and the surrounding areas rather sore. There were two reserve fangs on each side, but these had not come into use. It must have lost them in attempting to kill some animal, which escaped, though no doubt died later on. This specimen is probably exceptional as regards size. Wall records one 7' in length from Ceylon. One female specimen was killed whilst devouring a Green Keelback. Their average was 1,400 mm.

Naja hanna. (Tamil: Raj Naga Pambu.)

Not very common. Some years ago one was shot in the deciduous forest at 2,000 ft. and measured 16' in length. This is the only record I have of one being seen in this area.

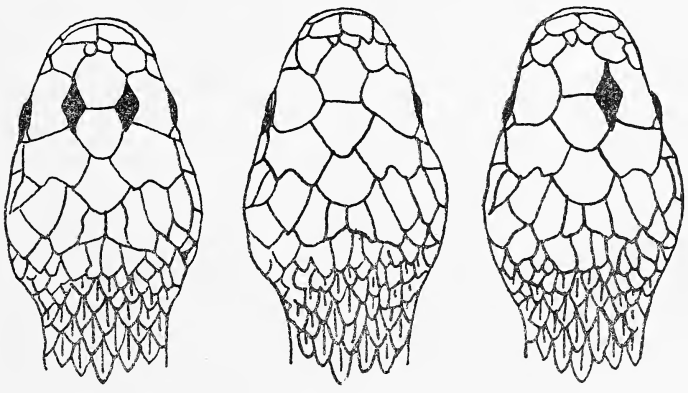
Family: VIPERIDAE

Vipera russelli. (Tamil: Kanna Vyrian Pambu.)

Two small specimens were taken in the lower part of the deciduous belt. Both were much lighter in colour than usual. They averaged 640 mm. in length. They are uncommon in this area.

Trimeresurus macrolepis. (Tamil: Chatti Thaela Pambu.)

This species is very common though confined entirely to the evergreen forest. It is often found in the loose leaves at the base of clumps of *Eeta*. After having seen three broods of young ranging from 4 to 7 in number, among the leaves at the base of these clumps (in October) I have come to the conclusion that they are born there, and only venture out after they have attained a size of 8″ or more. On danger approaching, the young hurry back to the protection of the leaves and completely bury themselves in them. I never found an adult accompanying these broods. Colour variations in this species are considerable, and range from dark-green (almost black) in the wet weather to light yellowish-green in the dry weather. Ferguson (Fauna Brit. Ind., p. 513) has noted similar seasonal colour changes in *T. malabaricus*. A number of the specimens caught had two fangs on either side in use and both were capable of injecting venom. One dissected specimen had 6 and 7 reserve fangs, in addition to 2 on each side already in use. They ranged from 3 to 15 mm. in length. Several specimens had damaged vertebrae. They are often met with in the monsoon lying on top of tea bushes, where they are almost invisible. We had three cases of pluckers being bitten on the hands. None of them were fatal though intense swelling took place and the patients' temperature went up to over 100°. The swelling usually subsided after 2 to 4 days, and finally after a week or so patches of skin surrounding the wound would slough. I was told that some years ago a two-month old baby was bitten on the neck by one and in spite of medical attention it died within 24 hours. This snake must do a lot of good in controlling rats, as many of the specimens caught had rats in their stomachs. One had swallowed three full-sized ones, and was extremely sluggish and made no attempt to defend itself on being picked up. The largest specimen taken measured 1,000 mm. but the average size was 570 mm. Out of 37 specimens caught, 15 had the two small scales, between the supraocular and frontal shields (fig. 1). Smith (Fauna Brit. Ind., p. 505) mentions this characteristic to be rare, but in these hills at any rate it is very common, as the above figures show. I have two specimens which exhibit only one small scale on one side only (fig. 2).



Head of *Trimeresurus macrolepis* showing extra scales
(After Smith)

Trimeresurus malabaricus. (Tamil: Vyrian Pambu.)

Two small specimens were taken in the tea area. It does not appear to be common. They averaged 480 mm. in length.

Trimeresurus gramineus. Only one specimen taken at the far S.W. end of the hills in evergreen forest at about 3,800′. Not common. It measured 420 mm. in length.

Trimeresurus huttoni sp. nov. Two juveniles belonging to the same brood were taken from beneath an *Eeta* clump in the evergreen forest. A search failed to reveal others in the vicinity. This species has been fully described by Dr. Malcolm Smith elsewhere in this number of the *Journal* (p. 596.)

In concluding these notes I would like to express my gratitude to Dr. Malcolm Smith of the British Museum (Natural History) for his valuable help and suggestions, and to the Curator and staff of the B.N.H. Society, who have helped me with many of the identifications ; to those of my friends who have helped me with the collecting I also wish to express my thanks.

The majority of the snakes mentioned in these notes are in my own collection, some I am giving to the B.N.H.S. museum and some to the British Museum (Natural History). Most of my live specimens, which were duplicates, were released after examination.

(*To be continued*)

JUNGLE MEMORIES

BY

LT.-COL. E. G. PHYTHIAN-ADAMS, O.B.E., F.Z.S., I.A. (Retd.)

PART III—PANTHERS[1]

(With two plates)

'A panther looks what he really is, a perfect swine,' says Col. A. E. Stewart in his very instructive book *Tiger and other Game*. But while every sportsman will most certainly agree with his description of the tiger (man-eaters of course excepted), as 'a contented gentleman or an angry one, but always a gentleman', I do not think that many will accept his definition of the panther. After all the latter is only a smaller edition of the tiger, and that he lacks nobility is due solely to his lack of inches—in courage and grace he compares very favourably with his larger cousin. Cunning he most certainly is to the nth degree, but that makes him all the more difficult to bag, and to outwit him on his own ground needs the most careful attention to detail.

Some people regard panthers as vermin, and admittedly they can be at times a very serious nuisance, but on the other side of the account must be placed their destruction of wild pigs, which cause so much damage to cultivation that Government have found it necessary to pay a reward for them in areas where panthers have been shot out.

'Beauty is in the eye of the beholder,' according to an Arab proverb and so opinions necessarily differ, but personally I cannot see any reason for disparaging such a fine sporting animal, whose skin makes a very handsome trophy, and whose pursuit involves that risk of danger which is the essence of big game shikar. It is not every one who can afford to go after tiger, but the needy sportsman will find the panther a very passable substitute.

Since the panther is in fact a miniature edition of the tiger, the methods by which he may be brought to bag are much the same as in the case of 'Tom Puss', but for all practical purposes they may be divided into three heads—beating, sitting up, and chance-met.

Beating for panthers is seldom successful, as they can run up a tree like a cat, or lie low in a bush not much bigger than a teapot and so remain unseen when the beaters pass, while if they are driven forward the chances are that they will pass unnoticed

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[1] To avoid confusion with the Cheetah or Hunting Leopard, I have throughout used the name Panther in preference to Leopard, but there is, of course, no difference whatever between the two names.

unless the stops are very carefully placed and the guns are well concealed. For the same reasons chance encounters are no more frequent than in the case of tigers, and the normal method of bringing a panther bag is by sitting up, either in a tree or on the ground over a bait, which may be the remains of an animal already killed or, as is more usually the case, over a live goat, whose bleating serves to attract the panther. Generally speaking I have found that sitting up over an animal already killed is more likely to produce results than the latter method, owing to the fact that the panther is already located, whereas with a goat he may not be within hearing. But it would be a great mistake to suppose that either method is infallible—even with the greatest attention to detail the result is by no means a certainty, while without that attention, sitting up is largely waste of time. I certainly sat up more than 20 times before I saw a panther at all, largely due, as I now realise, to lack of elementary precautions, and the lessons I have learnt are now being passed on for the benefit of others. It is of course impossible to guarantee success, but after all who wants more than a reasonable chance? 'Sport reduced to a certainty is sport robbed of its essence,' saying Thomas in *The Rod in India,* and that applies as much to shooting as it does to fishing.

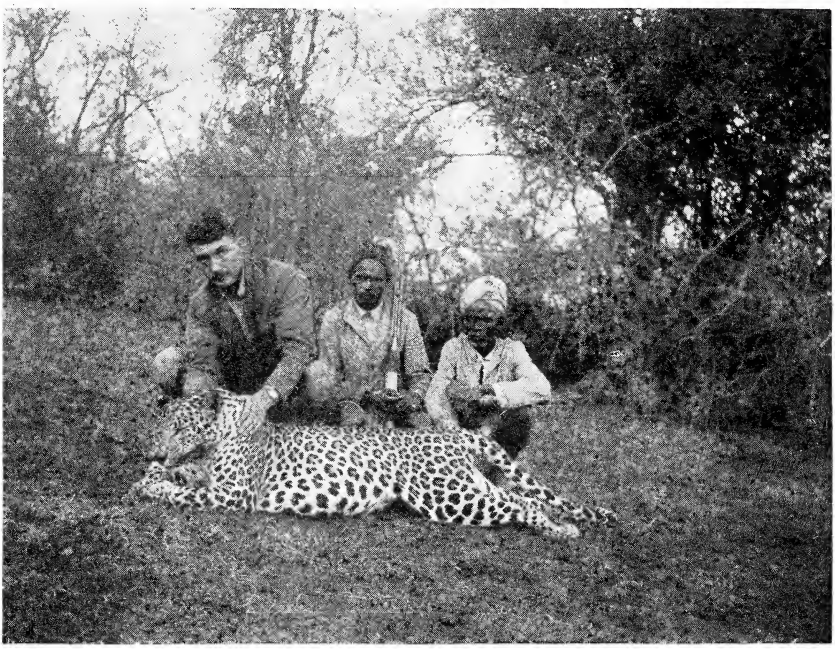
My First Panther

There is no truer saying as regards shikar than 'C'est le premier pas qui coute'. In the first 5 years of my service in India I had shot tiger, bear, oorial, gooral, black buck, chinkara & kakur, but I simply could not get a panther. Following the advice of other sportsmen I sat up again and again, but without result, and it seemed as if I was fated never to see a panther. Then in 1909 my luck at last turned, and after that I had no further difficulty.

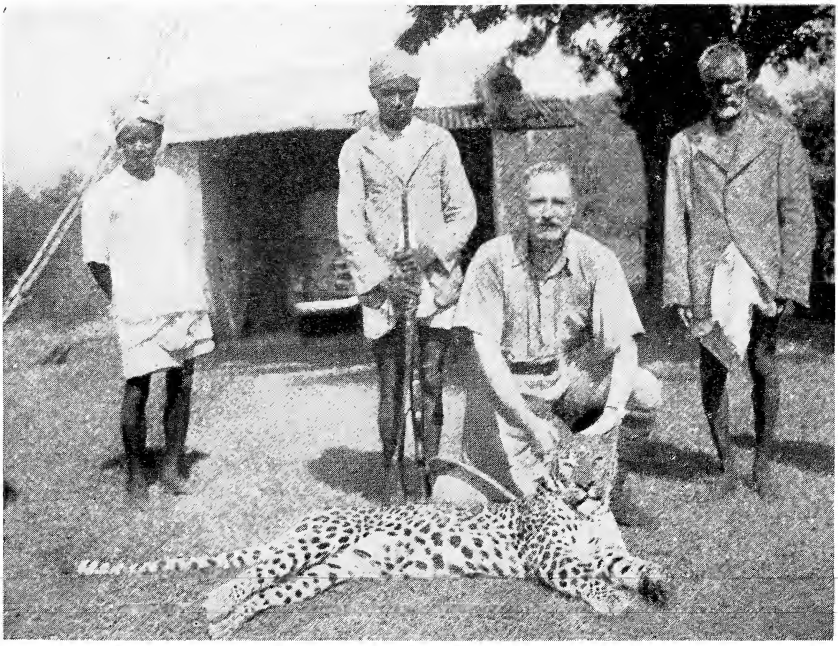
During divisional manouevres near Poona I noticed some hills north of Khadkala railway station which were said always to hold panther, so as soon as work permitted I obtained 3 days leave, and went into camp near the village of Somawrie. On arrival I was informed that a panther was lying up not far away, so the following day was spent in beating the slopes, but no panther appeared though I bagged a kakur, and a pig for the villagers. Next morning I started about 9 a.m. to honk the slopes above Jamboli, when a man ran up with news of a panther just seen to enter some thick jungle at the foot of a long spur, so I hurried off in the new direction. My first position was on the top of the steep bank of a nullah running uphill—the latter was about 100 yards broad and covered with jungle, and as I could not command the whole, I put a man in a tree opposite me on the far side. Not long after the beat commenced he signalled silently that the panther had passed below him, so I doubled about 400 yards uphill as hard as I could go to a place where the nullah was much narrower and I could command the whole. About 10 minutes later I heard something moving in the bushes and the panther came out some 50 yards away, quite unconscious of my presence though I was sitting in the open on a bare sloping rock not more than 15 feet above it. I fired at its shoulder with my No. 2 Express and knocked it over—it got up

Photo *H. H. Maharao of Kotah*

A panther sights the tie-up.



A big male shot at Anaikatti.



Photos *Author*

An Anaikatti panther with Kasabas.

again however with a roar and rushed uphill, when I got in another shot, a little low. Finding the hill too steep for its broken shoulder it turned back and lay up in the middle of a patch of thick cover some 50 yards long by 30 across in the bed of the nullah. Meanwhile the beaters had come up, so I ringed the place with some men up trees while the rest tried to stone it out towards me, but beyond extracting some savage growls and moving the brute 5 yards their efforts had no result. Knowing that the panther was badly wounded I called a stand-fast for half an hour—the monotony of waiting being relieved by a black pye dog which rushed into the cover and came out a lot quicker than he went in. Shortly after, a Bhil on the other side of the nullah who had partly descended the steep bank, said he could see the panther, and let fly with an arrow—she was out after him like a flash with a roar of rage and with the arrow sticking in her flank. The man dropped his bow and bolted uphill, and everyone roared with laughter. She was too crippled to follow him and withdrew to the thicket before I could get a shot in. Obviously the next move devolved on me so I crossed the nullah higher up and went down to where the Bhil had been. After some minutes I made out a patch of skin and fired, hitting as I afterwards found about the shoulder—that moved her a few yards and I then cautiously entered the jungle. At first I could see nothing in the chequer work of light and shade which blended so well with her coat, but at last made her out only 10 yards away and gave her a finisher with a shot through the back. The first 3 shots had all hit on or nearly on the shoulder (440 grain copper tubed bullets) and the vitality she showed was amazing. I have noticed in other cases that a shot a little off-centre is often attended with similar results, and that further shots, unless they hit the bull's-eye, tend rather to increased resistance—the explanation is I believe the secretion of adrenaline.

And so all was well and at last I had bagged my first panther—an old female with a very dark skin—not much in size but that did not matter! When skinning her we found the stomach distended with meat—the beaters had driven her off the carcase of a bullock killed overnight, and were delighted at her death, as she had been giving a lot of trouble. Nearly 40 years have elapsed but the memory of that day is still clear, and above all I shall never forget the picture she made as she chased the Bhil with the arrow sticking in her flank. I don't know that there is any particular lesson to be learned from the episode except that no liberties can be taken even with a badly wounded animal.

Beating

The following extracts from my diary show how disappointing beating for panthers can be in spite of my initial success:—April 20th. Another panther reported to be lying up over kill in deep glen N.N.W. of Rakaswadi, so beat for him but he broke out at side and came across plain to some jungle close to camp. Continued beating and shot a nice kakur. On return to camp at 5.30 p.m. heard about panther but decided it was too late to beat—had I

done so I should probably have got him, as he had killed and was lying up only 800 yards away.

21st. The man who went to look at goat tied up last night near camp walked on top of panther which had killed heifer last evening. We ringed him and I hurried uphill to cover his line of retreat, but the beat was blank as he had broken back due to beaters not keeping line. Went uphill and beat slopes from camp to Jamboli but saw nothing except a mouse-deer which came under my tree and at which of course I could not fire. Sat up in evening over kill but without result.

22nd. Went out before dawn and got on to line of retreat from kill. At 7 a.m. the shikari and a few others went to kill and made a little noise—the idea being that the panther would come out to me, but he had left before I arrived after eating more of the kill. Sat up over kill in evening—panther came within 50 yards judging by the monkeys cursing but would not touch the goat which I had tied up. Left goat out when I returned to camp at 8 p.m.

23rd. Off before dawn and found panther had again anticipated us—the goat had been killed and beyond the blood we could find no trace of it. Collected some men and beat the south hill from end to end, seeing nothing but fresh pugs of this panther and a smaller one. Then beat slopes on far side of hill and saw panther some 400 yards away race along in front of the beaters with his tail on end—he was just below the crest so they could not see him. The men beat well but he lay low or broke out somewhere.

24th. Beat the north hills but all we saw was a huge boar which I missed as he passed me at a gallop in the last beat. On the following day my leave being up I had to return to Poona.

My lack of success sitting up was due to the machan not being properly screened, and it was a mistake leaving out at night so small an animal as a goat—a young buffalo or a donkey would have been better. I see from my diary that beaters then cost only 4 as. per diem—what a contrast with prices today! I often wonder what the place is like now—quite probably the area is submerged by the lake which was formed some years later.

My experiences on that trip convinced me that except under specially favourable circumstances it is far better to sit up for panther, and the great majority of the 62 of which I have records have been obtained by that method. I have occasionally beaten for them in the years between, but do not remember ever getting a shot except once near Prome (Burma) in 1913, when an animal rushed past me in knee-high grass and a lucky snapshot rolled it over. And then I discovered to my regret that it was not the panther at all but an unfortunate monkey—however the Burmans ate it so it was not wasted!

Night Shooting

My first success sitting up was during a month's trip to Raipur in the Central Provinces in 1910. Some cattle had managed to get out of the village close to my camp during the night of the 3rd April, and a panther had killed one and mauled another as they were eating mhowa. I had a machan erected in a convenient tree,

and since there was no moon and the panther could not be expected till after dark so close to the village, I fixed a small electric lamp to shine on the kill. I was in position by 6 p.m. but it was not till 8.15 than I heard the sound of tearing. I raised my rifle and completed the circuit of the lamp, and then saw the panther behind the kill apparently petrified by the light. My shot was answered by a roar, but the lamp failed and I had to fire the left barrel at a venture, hitting as I afterwards found, the kill. I followed this up by a dose of buckshot from the 12 bore which apparently also missed. Soon after lights appeared from my camp which was only a few hundred yards away. The men came on carelessly in spite of my warning them, and my chokra Karim nearly walked on the top of the panther. He roared and they all bolted—fortunately no harm was done. I sent for more lamps and then got down from the machan and walked the panther up. At 10 yards he roared again and the lampmen wavered but I encouraged them and went a bit closer, when I was able to put in a finishing shot. He was a fine male. The first shot had caught him behind the shoulder high up and broken his back. I guessed that he was anchored or I would have left him till next morning. An interesting sequel was that when skinning him we found a large iron arrow head $4\frac{1}{2}$ inches long by $1\frac{3}{5}$ board under the skin of the head; the wound had completely healed, and all that was visible externally was the end of the shaft which was turned up at right angles and protruded near the ear. I have the arrow head still and have often wondered what happened to the man who loosed it; the local villagers could tell me nothing. From my diary I see that after the carcase had been cleaned up by vultures, one of the latter fell dead from the sky about noon close to my tent with a tremendous thud. The body was burst open from its impact with the ground and there was nothing to show the cause of death. I can only imagine that it had over-eaten and died of apoplexy!

Panther's Sense of Smell

Hearing that there were always a couple of panthers hanging round Visapur fort within easy reach from Poona, I went out there for a weekend to reconnoitre. I took only a bivouac tent and as little kit as possible, since everything had to be carried up the bad hill path over the col between the Visapur and Lohodgarh forts. I pitched my tent under a fig tree close up against the cliff face of Lohodgarh, and spent the next 2 days with Bandoo the local shikari exploring the country and the extremely interesting ruins and caves in the vicinity. I found that there were two water holes not far from the village—one under the southern slopes of Lohodgarh and one above the col between the two forts—and I tied up goats at both by night but without result. I then had to return to Poona, but left my camp standing with my orderly in charge and 3 goats to tie up. Some days later I received a prearranged telegram reporting kills, so got 3 days' leave and went out again. I sat up at what I named the 'South water' and after dark saw an indistinct shape approach the goat, which when I turned on my lamp, proved to be a hyena. He and the goat stood nose to

nose for quite half a minute, when I threw a cartridge at him and he bolted. I gave it up at 9.30 p.m. 'being eaten alive by large black ants' according to my diary! Next night I sat up near the col not far from camp, below a high bank, and a panther came down-hill behind and almost on the top of me before he bolted. To shoot was impossible. If I had had any sense I ought then to have given it up and returned to camp, but I continued sitting up the whole night, with of course no result. But I have at least one memory of that occasion—a magnificent view of Halley's comet spread across the sky above the ramparts of Lohodgarh, and a tree below the cluff face scintillating with hundreds of fireflies.

On the 3rd night the goat at the col was killed and carried off into some fairly dense but low jungle north of the fort, so I beat for it, sitting myself at the end of the 'Scorpions sting'—then tried the south side, and then back to camp, but though the panther was in each beat, I never saw it. I next went and looked at the kill which had been found in the first beat and put up a sapling by a beater. The jungle was so low that I could not find a tree for the machan nearer than 50 yards from the spot where the kill had been found, so I had the latter dragged 3 times to and fro to leave a trail, and finally pegged down in front of me. The machan was terribly exposed and only 8 feet from the ground (no higher tree was available) and when I climbed into it at 4 p.m. I had little hope of success, but there are times when everything goes right, and this was one of them. At 4.30 p.m. the panther suddenly materialised where it had left the goat, and then came across the open towards the machan noising the drag line just like a dog. When it reached the kill it sat up and licked itself. All the time I had been sitting rigid, but when it turned its back, only 10 feet from me, I very slowly raised the rifle and shot it through the spine—a young female with an abnormally long tail. I see from my diary that I had to skin it myself as no chamars were available. The episode is I think of special interest, as it shows that panthers do possess far more than a rudimentary sense of smell. The kill was comparatively fresh and not really 'fruity', so there cannot have been a great deal of scent, and yet this panther was able to nose it out and follow the trail. For the rest, it is hard to say which was the bigger B.F.—myself for sitting up in such an exposed position or the panther for not spotting me!

Shooting from a Pit

While on recruiting duty in 1915, I heard that a man had been mauled by a panther near Bommasamudram village about 10 miles from Vellore, so on the 16th April went out to prospect. Not far from the village was a long hill covered with scrub jungle, and with numerous caves formed by huge rocks piled one upon the other—an ideal place for panther. I spent the morning bombing some caves with rockets and exploring the larger ones. The latter sounds rather a foolhardy proceeding but I had read that tigers were obtained this way in Korea. However, nothing resulted and as there were no trees for a machan nor bushes thick enough for a hide, I had a dug-out made in an open field some 100 yards from

the hill. My diary unfortunately does not give the dimensions of the pit, but I remember that it was big enough to hold myself and my orderly. It was roofed with poles, bushes and grass over which earth was spread and levelled out to match the surrounding ground. There was a small loophole not more than a foot high and about 6 inches broad, and the hole for ingress was closed by a bush. When completed it was very hard to distinguish even from a short distance. The bait was a sheep, as no goats could be obtained, and a small pye-dog was also tied up to add attraction. Nothing happened the first night though I was pretty sure that the panther was in the vicinity, and on the second night I put my orderly in the pit with a single barrel 12 bore while I sat up elsewhere. About 10 p.m. I heard a shot from the dug-out and shouts, so went over and found that the panther had killed the sheep and that the orderly had fired but missed it. I returned to my own hide and half an hour later heard 2 more shots. This time there was no mistake and a fine male panther lay dead alongside the sheep; the pye puppy—poor little beast—was untouched. This panther had mauled 3 men and the villagers had been afraid to leave their houses after dark for some months past, so he was well out of the way. When skinning I found a lot of prickly-pear thorns in chest, fore-arms and tail all turned quite black; they cannot have improved his temper.

The same dug-out was used a month later with equally successful results, and this method is recommended when the ground is open and no suitable tree or bush is handy. But the stifling heat is a drawback, and also the difficulty of firing through such a small loophole. One has to be very careful too not to get earth down the barrel of the weapon. Both these panthers were shot with Destructor bullets from a 12 bore, and were laid out on the spot. Under such conditions an electric light is out of the question so the brighter the moon the better. If possible the bait should be outlined against the sky, and not more than 5 yards away from the loophole.

The Ghatkesara Panthers

No further opportunities with panthers occurred till 1921, when I rejoined my regiment in Secunderabad after its return from Mesopotamia. From General E. F. Burton's *Indian Olio* I knew that Secunderabad had been a good sporting centre in days gone by, so as soon as we had settled down I started exploring the various roads out of the station. One afternoon towards the end of April I went down the Bhongir road about 14 miles and spotted a very likely looking hill near the village Ghatkesara. It was the usual Deccan type of kopje, with a number of thorny bushes scattered over it, while huge piles of rocks indicated caves. Local enquiries elicited the information that a panther had killed several goats recently, so I engaged a Secunderabad shikari and sent him to make the necessary arrangements. On the 1st May I went out again and after a very hot run reached the village about 5 p.m. The shikari had fixed up a hide of bushes (locally known as a 'mart') at the edge of a small dry tank at the foot of the hill, and

the goat was tethered about 15 yards away. I sat up till 7.30 p.m. when I gave it up as there was no moon. Next evening when I reached the village the shikari told me that the panther had followed us back almost to the road, and later had killed a goat which he had taken into a small cave in low rocks at the base of the hill. This time the machan was in a tree and the goat about 7 yards away; I fixed up the electric lamp and got into position about 5.30 p.m. At 7.30 there was a sudden rush and the panther seized the goat, broke the rope and was away up the hill before I could raise my rifle. I heard him tear the goat open not far off,—that unmistakable sound of a feline feeding—but it was useless going after him. So I quietly left my machan in order not to disturb him (with a view to future eventualities) and went back to the men, who were waiting some 400 yards away. With more experience I should have realised that this was a big male panther and not the one I had been trying for till then; however I was to deal with him in due course. Next evening found me sitting up again, this time in a mart on the ground at the foot of the hill. Till dusk I kept the rifle handy, but after that changed it for the 12 bore with a Lethal bullet in the right and buck-shot in the left. I had an electric lamp fixed to a bush some yards away from my hide, and at 8.30 p.m. feeling it was hopeless to stay longer told the shikari to turn on the light to test it. I saw what looked like a panther some 30 yards beyond the goat, but the light went out before I could be certain. However, when it was turned on again I saw a small panther walking past behind the goat, and had a quick shot but missed. After this I determined to give him a couple of days to get over his scare, but on the 6th May was back again with a new plan. I felt sure that the goat had been tied too close on previous occasions and that the panther was shy of any suspicious looking bush, so ordered the goat to be tethered 70 yards away when the flock was driven past. I watched till dusk but nothing happened, so I withdrew to a machan previously prepared, and had the goat fastened within close range. While we were moving back the shikari told me that he had seen the panther on the rocks and that he was sure to follow us. He did so, but it was too dark to see him under my tree, and as he refused the goat I had to give it up. It was disappointing to have spent so much time and trouble in vain but I felt sure that perseverance would in due course be rewarded, and next evening was to prove me right.

I purposely arrived earlier than usual, and by 5 p.m. was in my hide between two big rocks with the entrance well bushed—the goat was tethered 70 yards away and called well. At 6.30 p.m. I saw the panther sitting on the rocks beyond staring down at the goat, and fired at his shoulder, but underestimated the distance and the bullet struck low, tearing the skin off his chest and the muscles of his fore-arm, as I found later. At the shot he made a tremendous bound high in the air, landing some 20 feet down, and then turned and looked up at the rock he had just left, evidently wondering where that nasty blow had come from. I stood up and fired again but apparently missed, and he turned up the ravine

at a slow trot. I jumped on to a rock and had 2 more snapshots both of which hit him as I knew by his answering roar. At the head of the ravine he turned left and tried to get back to his cave, but a rock he had to climb was too much for him and just before he reached the top he fell back. A cautious approach showed him lying dead—a small male with a long tail.

After a couple of days I went out again to prospect and found, as I should have realised before, that there was still another panther, a big male which had killed 3 goats near a well the night before. It was then too late to do anything, but next evening found me at 5.15 p.m. in a mart among the rocks at the foot of the kopje with the goat 70 yards away. The position was however badly chosen as I could not see the panther if he came out of his cave or till he was near the goat. At 6.45 p.m. I got fed up and whistled up the men, and as we went to untie the goat I thought I saw something move in the bushes 50 yards away halfway up the hill, but could not be certain—it might have been a hare but may have been the panther. Thinking matters over I felt sure that we were wasting our time working the west side of the kopje which overlooked both the railway and the main road not far distant, whereas the east side was towards the open country and the panther might be expected to emerge earlier. On the 12th afternoon I therefore occupied a hide overlooking the east slope; the flock of goats was driven right over the kopje, and as they passed one was tethered about 50 yards below me at the foot of the hill. The flock had not gone 5 minutes before the panther appeared in the mouth of the cave about 150 yards away—after a good look all round and at the goat he lay down and surveyed the country for a full hour. Satisfied at length that all was well, he then started to come down the hill and it was a pretty sight watching the stalk. At one place, evidently out of view of the goat, he sat down on a sloping rock and slithered down till it became too steep when he jumped the remainder. He was still too far for a shot, and by the time he had got within 30 yards of the goat it was getting dark and I could hardly distinguish him even with my glasses. I did not want the goat killed unnecessarily, so quietly left my hide, unfastened the goat and went downhill whistling to the men who were some 400 yards away. I neither saw nor heard the panther go, but of course he did. Evidently he was a bit puzzled, as after I had left he walked round and round the place where the goat had been tied, and also rolled in the sand there.

Next evening saw me in another hide by 5.15 p.m.—this time at the foot of the rocks at the south end of the kopje. The goat was below me and about 15 yards away. My position thus covered from a flank the panther's probable line of approach. As on the day before, the flock had not been gone 5 minutes before the panther came out of the cave. He was hungry for, so far as we knew, he had killed nothing for 4 days, and within a few minutes he started to descend. Half way down the hill he turned up a cleft of rocks away from me and I nearly fired, but he had bounded up too quickly. A minute later I saw a bit of him as he took up a

position in the shade behind a large rock. All I could make out were his head and paws for the next 45 minutes, and several times I thought of firing but the shot was a difficult one, and I hoped that by waiting I might have a better opportunity. Besides making a general survey of the country he several times stared intently at the hide, and if I and the orderly had not kept absolutely motionless he would certainly have spotted us; he had good cause for suspicion as we found later. At last about 6.30 p.m. his head was withdrawn and I knew that he would shortly re-appear in the cleft, so got ready to shoot. Just as he was about to jump down I fired at his throat. He fell over and for a few seconds was motionless, then got up and went behind the rock where he had been lying so long. I climbed on to a boulder and saw him standing still, looking very sick, halfway up to the cave. I fired again but was unsteady and missed, and before I could reload he had reached the cave. The approach to it up the hill was not pleasant but there was no other way, so taking the 12 bore loaded with buckshot and closely supported by my orderly with the .405 Winchester, I cautiously advanced. A heavy blood trail led to the cave, inside which we could hear a deep sound of breathing. The cave mouth was wide but I could at first see nothing, till the shikari pointed out the panther lying in a cleft between two rocks about 5 yards away—he was motionless but still breathing so I brained him. The first shot had broken the left lower jaw and passed on into the body, nearly coming out behind the left shoulder, so he would not have lived long in any case. He was a fine male and had an old wound on the withers apparently from a small bore rifle. The injury was on both sides of the spine, and must have been caused by a bullet fired when he was crouching, otherwise his back must inevitably have been broken. The new hair was just growing round it—no wonder we had so much trouble bringing him to bag. I remember that when we got back to my bungalow in Secunderabad, every dog in the neighbourhood started to bark furiously, having no doubt got the panther's scent.

A fortnight later I shot 2 more panthers a few miles further on, both at the first attempt. One came on to the rocks overlooking the goat and I killed him with a single shot from the hide. The second was spotted sunning himself on some rocks on our way out and a long shot at him missed, but this did not deter him from following us and rushing the goat at dusk. I fired at what I thought was the centre of his chest, but the bullet went through the loose skin of the armpit. He rushed straight downhill at us and I had just time to stand up and fire a point blank shot into his face. I do not for a moment suppose that he was charging; no doubt he was simply bolting away from the echo of the shot, and the crack of the bullet on the rock behind him. But all the same it was closer work than I like and shows how desirable it is to be above the goat. In this case there was no alternative to siting the hide downhill.

At the risk of being tedious, I have dealt with the first two of these panthers at some length, to show how necessary patience is to circumvent these cunning brutes. Altogether it took me

nearly a fortnight to bring them both to bag, and I sat up eight times. With more care in selecting the sites for the hides, time would undoubtedly have been saved, but I had my duties to attend to in Secunderabad and could not get away till the afternoons, so had to leave most of the arrangements to my shikari. Even so, and granting that one of the panthers was unusually suspicious owing to his former wound, I feel sure that more personal attention would have produced a quicker result. Later on I shall give full details regarding the construction of hides and bandobust generally, so will only add here that except in very special cases it is better to tie up the goat within 15 yards of the hide, and that 70 yards was much too far.

Machan Shooting

Having dealt with sitting up on rocky ground, I will now select some incidents of shooting from a machan which seem to me of special interest. The first was in December 1929 when one of my young buffaloes was reported killed on the Sirur road about a mile from the Forest Rest House at Anaikatti. I sent two men to put up a machan, warning them to be particularly careful to cut the wood some distance away, and also to screen the machan all round. News then arrived of a second kill across the river some miles away in the opposite direction, so I proceeded there and had several beats which proved blank. I was back at the bungalow by 2.45 p.m. and after a hurried meal left to sit up just as a message arrived asking me to hurry since the panther was on the move. By 4 p.m. I was in the machan which had been built in one of a number of close growing trees in the bed of a nullah. The kill was about 20 yards distant—all one hind quarter had been eaten and the whole stomach carefully removed, which indicated a large panther, as indeed his pugs showed him to be. He was expected to return either in front or to the right, but I was not too happy about the nullah behind me, as the machan, in spite of my instructions, was not well screened on that side. However there was no time to do anything as a sambar was persistently belling uphill and the panther was obviously not far off. At 4.30 p.m. a red mongoose arrived and it was very amusing to watch her—I say 'her' because from the size it was obviously a female in what is sometimes described as 'an interesting condition'! She worked round and round the kill and took at least half an hour to decide that it was safe to approach, when she at last started feeding, her mate joining her shortly after. The sambar was again belling at 6 p.m. and as I calculated that the panther was still some distance away, I took the opportunity, before the light failed, to fit the electric torch to the side of my 12 bore—which of course I ought to have done as soon as I got into the machan. I had not used one before and failed to realise that some noise was inevitable. However it did not seem to worry the mongooses. Half an hour later the light went, and at 6.45 p.m. I saw the panther, a grey nebulous shape, coming from under my machan towards the kill. I waited till it started eating, and then raised my gun, but in spite of all my care the torch clinked against the barrel and then

came off in my left hand, so that I had to fire with the right only. I felt sure that I had put the charge of buckshot into his shoulder, but he did not answer the shot and we never saw him again, nor did a search at dawn reveal any blood or other signs. That I lost him was entirely my own fault; I should have seen to the proper fitting of the torch as soon as I got into the machan, and it would have been far better to have used the rifle. Buckshot is all right for close range and especially for following in thick cover, but it leaves no blood trail as a bullet does.

In September 1936 I was again in camp at Anaikatti, this time accompanied by a friend. We had two young buffaloes tied up and the first night one was killed, so having won the toss, I went to sit up the following evening. The machan was in a fine tamarind tree overlooking a broad sandy nullah in which lay the kill some 15 yards distant. Only a little had been eaten off the buttocks so the panther might be expected early—in fact the man who was keeping the vultures off told me that it had approached a short time before but had been driven away by a herd of Badaga buffaloes grazing in the vicinity. I had the latter shifted some distance and was settled in the machan by 4 p.m. It was very comfortable, and well hidden by the broad branches and heavy foliage of the old tree. By leaning back against the trunk I could keep an eye on the nullah to the right up which the panther had retired and by which she would presumably return. Time passed pleasantly watching a small white-bellied drongo hawking insects, and a young white-browed fantail flycatcher being fed by its parents; it was amazingly tame and was often within arm's reach. At 5.45 p.m. out of the corner of my eye I saw the panther behind the tree coming towards the kill and on my left. She looked a pretty sight with the tip of her tail curled and her beautiful colouring in the evening light. Beneath the machan she stopped to look at the kill and under normal conditions I should have waited till she started feeding before I took the shot. But there was a path close by up which someone might pass and scare her away, so I determined to fire at once. Cautiously lifting the rifle I tried to point it at her and as I did so her hindquarters sank down. I feared that she had heard some slight movement of mine and that I had messed things up, but all was well, and by craning over I saw that she was sitting up beneath me and still gazing to her front. It was a most awkward shot, as I could not get the butt to my shoulder and had to fire the rifle rather after a fashion of a two-handed pistol, but the bullet went true, catching her between the shoulders and passing through the heart—she could not have been 12 feet away from the muzzle. After a few gasps she lay still and I whistled up the men who were delighted that I had at last broken my run of bad luck in these jungles. She was an old female with blunted upper canines and taped 6 feet 6 inches between pegs.

We had hardly started back when my driver G. who was with me, saw a panther's head peering out of the bushes, so I was not surprised to learn next morning that two panthers had visited the kill during the night and gorged heavily. It was B.'s turn

to sit up and I urged him to take a torch as I felt sure that after such a heavy meal the panthers would not return till after dark, but he was prejudiced against the use of artificial light (every one is of course entitled to his own opinion), with the result that when they arrived he could not see to shoot. The panthers were very noisy, and were probably trying to intimidate a hyena, which was shot later the same night by G. who relieved B. at 8 p.m., after the latter had given it up as a bad job. If B. had only taken a torch he would at least have been able to see what was going on beneath him, and almost certainly have got a shot.

December of the same year found me back again at Anaikatti, and on the 27th my shikari Kunmada, reported that a large cow had been killed by a panther the night before, close to the village. Only a little of the brisket and some guts had been eaten so an early return might be expected. The ground was dry and hard, and the short grass showed no pug marks. The machan was in a 'ber' tree, very low and insecure, with the loophole looking down at the kill not 10 feet away, and I was not very hopeful as it was not well screened and the slightest move would be detected. I was in position by 4.15 p.m. and half an hour later six buffaloes came down the path and sniffed at the kill. One licked the dead eye, another blundered into my tree and shook the machan, but after some snorting they finally cleared off. Before 5 p.m. I heard a peafowl trumpet (that sure sign of a feline and quite different from the normal call) not far away, followed by the sounds of startled flight—possibly the panther had made an attempt at it—next, spotted deer called within 70 yards. Two grey mongooses appeared and ran round the kill but did not stay, and then I heard a bird twittering down the path behind me. Cautiously looking over my shoulder I watched that side but could see nothing, then facing round saw a panther sitting in front looking at the kill not 15 yards off. A mass of overhanging branches prevented a shot, so I had to wait, but that did not matter as there was still plenty of time before dusk. A few minutes later the panther rose, went back 10 yards and lay down, when a second appeared on the scene and approached the first, which greeted its mate by arching its tail over its back. The second panther then came towards the kill and when only 5 yards away spotted the machan and gazed at it intently. My loophole was a large one for night work and I must have been pretty visible; her eyes met mine and she turned and went off at a fast walk. I was afraid my chance was gone, but peering over the top of the screen I saw No. 1 beyond some bushes standing sideways on about 40 yards away and looking after No. 2. Luckily I had a clear view of his shoulder so fired. There was a flurry of dust and he was gone, but I heard him rolling about not far away. Calling up the men we found a good blood trail but the bullet had obviously passed through, and as the bushes were very thick I sent back to the bungalow for my 12 bore and buckshot cartridges, and for the dog. On their arrival about 6 p.m. we again advanced stoning the bushes, and turning a corner saw the panther lying dead—a male of 6 feet 10 inches but with a long tail. I was

lucky to get this panther at all, after being spotted in the machan, which was my own fault for leaving such a large loophole. I should have blocked it with leaves till it was required.

I decided to sit up for the female on the following evening and selected another tree for the purpose, but that night hyenas completely demolished the kill. In this case it was obviously necessary to shift the machan, but it will often happen that the same one can be used again, as shown in the account of the panther shot from the tamarind tree. I had a similar experience in May 1939 when R. sat up over a kill on the 25th and shot a panther. Another returned to the kill later the same night and I shot that one over a fresh tie-up on the 27th using the same machan.

In such cases the dried branches must of course be replaced with fresh ones, not only on account of visibility, but because withered leaves crackle with the slightest movement. Some books on shikar advocate bushing the underside of the machan—this seems to me not only unnecessary but likely to make it too bulky, and thus more liable to catch the eye of the approaching animal. Any ladder must of course be removed; nothing is more noticeable than a bamboo with branches cut short for this purpose. The machan itself must be well bushed *all round*, high enough to prevent the occupant being overlooked from higher ground, and thick enough from base to top to prevent any movement being seen. So far as possible one should sit motionless, but occasional movement is unavoidable to counteract stiffness; a rug and a thick cushion are aids to comfort. Some people find sitting up boring and take a book to read. Personally I prefer to watch the birds and the life of the jungle in general—it is only after dark that one finds the time drag. Smoking I feel sure is undesirable, since the smell of tobacco carries so far, and unmistakably indicates the presence of man, while the smoke rising above the machan may catch the animal's eye by day, or the glow of a cigarette after dark. It is definitely a privation for a heavy smoker like myself, but should be endured in a good cause. How long to sit up? If the panther has not come by 9 p.m., I doubt whether it is worth staying later. Much of course depends on when the kill took place and how much has been eaten; also whether the locality is a quiet one or liable to disturbance. Generally speaking it is better to sit up alone, but it is not at all a bad plan at times for the shikari to sit up with one and for him to leave the machan at dusk. If the panther has previously had suspicions, the sight of a man leaving may make him believe that all is clear. I have known this work on more than one occasion. If you have decided to sit up after dark, you will of course take with you some citronella oil or other anti-mosquito preparation, and will have arranged some form of electric light—either a torch clipped to the barrel of the rifle, or a small lamp directed to shine on the kill. I have seldom used these devices myself but cannot see any reasonable objection to them. The whole object of big game shikar should be to kill as cleanly as possible, and surely it is far better to use an electric light and make sure of your shot, than to fire more or less blindly in the dark and risk losing a wounded animal. One has quite

enough difficulties to cope with in any case without adding to them. If you are using a torch clipped to the rifle, your loophole must be large enough to accommodate both, but during daylight it should be reduced to minimum dimensions either with leaves or a green silk handkerchief. A stout bar beneath it will serve as a rifle rest while waiting, or to steady the weapon when taking a shot. If the sun is shining towards you, it will be better not to allow the muzzle of the weapon to project while waiting, lest some glint from it should catch the panther's eye.

Some books advocate a supply of stones to drive off the vultures, which if they have found the kill will quickly finish it, as soon as your men have withdrawn. I am inclined to think it is better to leave them undisturbed. Even if only bones remain, the panther is pretty sure to come and sniff at them to see whether anything is left, whereas if he finds the birds perched in the trees, he is liable to be suspicious. Panthers have a habit of approaching a kill by stages, and if he happens to be watching from a short distance when a stone is thrown, he will realise that there is something uncanny about the spot, and your chance will be gone. As regards taking the shot, it will be best to take the first suitable opportunity, as something may occur to disturb the panther and he may not return. You will of course load your rifle as soon as you are settled into the machan, and put the safety-catch on—rifles have before now slipped from the machan and exploded on reaching the ground. It is equally important to unload your weapon before descending. All these may seem unnecessary details, but it is by attention to them that success will be achieved. The most important point of all is rigid immobility and a minimum of movement. Do not believe because you cannot see in the dark that a panther is equally hadicapped—his vision is quite as keen by night as by day.

Sitting up on the Ground

When sitting up over a kill, if no tree is available for the machan, a hide can be made on the ground by hollowing out and thickening a bush, and the same method may be adopted when sitting up over a live goat, as the following case shows.

In November 1930 I was shooting green pigeons down the Chamrajnagar road about 3 miles from Gundlupet, when a villager told me that a panther had killed his cow overnight. Except for scattered clumps of lantana there was no cover for miles, but a search revealed a fine animal lying dead in some bushes not 50 yards from the main road. I thought it best not to disturb the locality by beating, and as the ground did not permit the construction of a hide covering the kill, I had a bush hollowed out a short distance away and sat up over a live goat that afternoon. The men had not left me 3 minutes when there was a rush and the panther had seized the goat; a shot through the head finished the matter. This case shows how a panther may be attracted by the lure of a live bait, even though its kill is fresh and only partly eaten.

But such easy success is not often achieved, and though I have shot many panthers from a hide on the ground, I doubt

whether this method offers on an average more than a 1 in 3 chance, for a variety of reasons. The panther may not be in the vicinity at all, or he may be too suspicious to take the goat before dusk (I now never sit up on the ground later than that), or he may spot the occupant in the hide and refuse to kill, while the goat may also decline to call, though that can be overcome by having a second goat handy to answer your tie-up, or if necessary to replace it. Difficulties however are the essence of sport, and personally I find this method an extremely attractive one—in fact it has given me most of my panthers—so I will now select some examples from my diary.

When I first visited Gundlupet in the Mysore district in 1926, there were a lot of panthers about, constantly killing goats and cattle, but the local shikaries were simply small-game men and knew nothing about panther shikar. Consequently I had to make all the bandobust myself, which after all is the most satisfactory way. On my first visit there was no time to prospect, so relying on information received, I sat up over a goat at the foot of a hill about one mile from the travellers' bungalow, but as might be expected, without result. Next morning I pushed further afield and found fresh pug marks of panther near the edge of State Forest beyond the village of Bhimanbid, and the cowherds informed me that one usually lay up in a thicket close to an old tank—a very likely spot. A cart track ran past this, and I found that the only suitable bush was on the far side of it, so constructed a hide there. I was in position by 5 p.m. with the goat 15 yards away across the road and close to the thicket. It was not an ideal place as herds of cattle were continually being driven past on their way back to the village, but about 6.30 p.m. things got quieter, and I then heard some birds twittering in the bushes uphill behind me, and later a squirrel in a banyan tree on my left—obviously the panther was on the wrong side of the road and not in the tank thicket at all. At 6.40 p.m. a single man passed hurriedly down the road—we learnt afterwards that he had seen the panther crossing it. Ten minutes later there was a rush, and looking through my loophole I saw the panther holding the goat by the throat. The latter covered the panther's chest so I had to wait till it dropped unconscious and then fired a Lethal bullet from my 12 bore. At the shot the panther sprang forward a couple of yards, then fell and rolled about evidently badly hit, but I did not like to fire my left barrel, as his line of retreat would probably be past the open end of my hide, and I preferred to reserve it for close quarters; that is the drawback to a double barrel as compared with a magazine weapon. However after a few seconds the panther suddenly picked himself up and dashed away towards the old tank and my hurried second shot missed. It was now too dark to follow up, so we had to leave it till next day, when I spent over 2 hours searching the dense lantana thicket, covered by heavy stoning, and expecting a charge every second. But to make a long story short that panther was never retrieved, though with such a wound in his chest he cannot have gone far.

A bad start! but I did have the satisfaction of saving the goat by dressing the wounds with carbolic.

Next evening, after the usual reconnaissance, I sat up again about a mile away for another panther. The goat (not the same one!) was very nervous, and as soon as the men left flung itself to the ground where it lay tangled up with the rope, and uttering an occasional feeble bleat. After a few minutes, hearing no sound, I looked through the loophole, and saw a yellow spotted heap behind some low bushes a few yards beyond the goat—this materialised into a panther which rose and stared at the goat in some perplexity. This time I was using the rifle, but the shot was followed by the same performance as the day before—jump, tumble, rush and fruitless second shot. But this time I could see blood on its side as it dashed away, and there was a good blood trail for about 50 yards into a nasty thicket. I ringed it, and finding that the panther had not left, followed up the trail cautiously and soon saw it lying dead—a lanky female of 6 feet 10 inches.

I then had a run of bad luck and sat up 6 times without result. On one occasion the goat would not call (I had not then thought of having a second goat), and on another, though we had seen the panther on the rocks that morning, he refused to take the goat—quite possibly my topi was visible from the hill over the top of the hide, which was not high enough. Next morning he was on the rocks again accompanied by a mate and I tried a stalk. I might have had a shot at 200 yards but that was a good deal too far for certainty, so I did not fire, and after they had gone constructed a new hide in a cleft between two rocks. The male, whom I named 'Old Sala', had done me several times before, and as he was such a cunning beast I went out alone very early in the afternoon with a sari wrapped round me, and pretended to be an old woman picking up sticks. It was not very likely that he would be watching at that hour, but I was not taking any chances. Approaching the hide slowly and with constant halts, I got into position by 3.30 p.m. and the goat was tied up by 4 p.m. Soon after I heard birds chirp on the hill and at 4.20 p.m. there was a rush. I looked out and saw the goat lying dead and the panther with his ears laid flat looking all round at every bush and rock. Before he could spot me I shot him through the shoulder. He lurched off a couple of yards and then dropped—a very thickset old male with a head like a small tigress, but owing to a short tail he taped only 7 feet. Analysis shows that on this trip I sat up 10 times and got 3 panthers, so I think my estimate of a 1 in 3 chance is about correct.

A year later found me again sitting up in the hide from which I had wounded and lost the first panther. As before, cattle kept passing towards the village, and at 6 p.m. two men driving a herd began to beat their beasts vigorously, calling out 'Ibba—Ibba'. I knew they had seen the panther, so cautiously peeped through the loophole and saw its head 30 yards beyond the goat and staring at it—the latter was still looking in the direction the cattle had gone and had its back to the panther. I wanted to

save the goat, so opened the loophole and pushed the rifle out, and as I did so the panther came forward at a crouching run, then sprang and seized the bait before I could shoot. I fired at the front of the left shoulder near the neck, and it dropped on the spot with the goat still twitching in its jaws. Not being quite certain whether it was dead, and remembering what had happened previously at the same spot, I stood up and fired again at the back of the neck and the shock of the bullet made it release the goat which however was dead. This was an old female with worn teeth but only 6 feet 5 inches in length. My diary records that first her head, and later as she advanced, her whole body looked uniform brown colour, with no sign of spots; this was in dull light with no sun. It is extraordinary how their colour appearance varies—at dawn or dusk they often look grey. No doubt the light has much to do with it and the angle at which the animal is seen, but I cannot help thinking there is something still to be learnt in connection with the position of the fur, when either lying flat or partly raised.

I remember some years later shooting from the same hide a panther which held the goat in such a way that its head covered the panther's chest. As I was sitting on the ground and on the same level as the panther, I did not care to take the head shot, which was all that offered, since the bullet might so easily glance off. So I fired at the goat's head which was of course blown to pieces; the panther was killed stone dead. Normally however a shot in the centre of the chest, or if sideways on through the shoulder and heart, will either lay the animal out on the spot, or it will be found dead within 50 yards, and generally much less.

One unusual case happened when the bullet must have exploded on the shoulder, and the panther, a small beast, rushed away leaving behind the ball and socket joint. With such a wound it is difficult to believe that any animal could go far, but this one got away without offering a second chance, though it was found dead next day. I remember that when following up rather casually I peered under a thick bush and found myself practically face to face with the animal, but fortunately it had no thought of retaliation. For following up I find the best weapon is a 12 bore loaded with buckshot—it is far handier than a rifle. But I prefer the latter for shooting from the hide.

As regards method of killing, my experience is that a panther seizes the goat by the throat and holds on till strangulation ensues, but large male panthers often exert such violence that the bait is killed on the spot. If the panther is shot before the goat is dead, the wounds in the latter's neck can be cured by washing out with carbolic solution. When a dog is tied up it may either be seized by the throat or killed outright by a bite at the back of the skull, but personally I never use a dog unless it is unavoidable, as the unfortunate beast, unlike a goat, realises only too well what is likely to happen.

I had an interesting experience in 1933 when two panthers, both young males, rushed the goat simultaneously. I shot the larger which was holding the goat, when the second seized it

and stared at the hide only 14 yards away. Quickly reloading I fired again, when the goat, which incidentally bore no marks of either teeth or claws, stood up and sniffed at the nearest body. As my men approached they called out to know why I had fired twice, and would not believe that I had shot two panthers till they saw them lying dead close together. I quote this case to show that for all practical purposes a magazine rifle is just as good as a double barrel, and it has the advantage of further rounds in reserve, whereas the double takes an appreciable time to reload.

As will be seen from the episodes narrated above, by keeping a careful watch it is at times possible to shoot before the bait is seized. Twice I have seen a big male panther which had a kill nearby, come and inspect the goat without attacking it. At one I managed to get a shot and bagged what proved to be my largest panther, 7 feet 6½ inches between pegs, but the other spotted the rustle made by the leaves of the loophole as I pushed the rifle out, and was gone before I could take aim. On another occasion, a small female came at dusk and jumped several times right over the goat—she looked like a puff of smoke in the fading light, and as she gave no chance of a shot I had to collect the goat and come away. The above incidents are given to show how important it is to be constantly on the alert, but to relate further episodes of this type of shooting with all its inevitable failures, would be boring, so let the above suffice and let us now consider how to set about things.

How to make a Hide

We will assume that you have information of cattle or goats being killed in a certain area, but this is not enough; you must so far as possible locate your panther. I find the best plan is to go out in the morning and to ascertain from villagers and goat-herds when the last kills took place, and where the panther is in the habit of lying up. Then by circling round the spot and looking for tracks in nullahs and near water, try to locate him still closer. Unless you do this you will probably be wasting your time sitting up for a panther which may be miles away. A very likely place is a small rocky hill with caves, and we will assume that you have reason to believe the panther is lying up in one. The next thing is to decide the location of the hide, which postulates a thick bush about 4 feet high, and an open space to tie up the goat about 15 yards away, and in view of the hill. This is important, though in the case of a thicket, the goat's bleating alone should suffice. In any case the goat MUST be up-wind of the hide, or he will recognise your presence, and fail to do his little bit. The panther's probable line of approach must also be considered, and if you can flank it, so much the better. Make the hide NOW, and do not put it off till the afternoon—the less disturbance there is *then*, so much the better. Having selected your bush, hollow it out and thicken the inside with branches and leaves from top to bottom, not forgetting the lower part, or the movement of your feet may give you away. Your object is to secure complete protection from view without altering the external appearance of the bush,

so use only those branches and leaves which match it reasonably well. These should be cut some little distance away, and no clearing done in the vicinity except to give you the necessary field of fire. Do not build up the walls too high or it will make the hide too conspicuous—besides you may want to stand up and take a shot over the top if the panther proves aggressive or it becomes necessary to give him a second shot. The back I generally leave open to facilitate egress, but if there is any chance of the panther approaching on that side, then it should be built up. When the hide is finished test the loophole and remove any twigs which obstruct your view—then blind it with soft leaves which will not rustle when the rifle is pushed out to shoot, and retain only the smallest possible peephole through which you may watch the goat. Then hammer in the goat's peg (unless a handy root will serve the purpose) and clear up all loose leaves and branches from the vicinity. If the peg shows up white rub it with a little earth. The impression you want to make is that the goat has somehow got a fore-foot entangled in a root and cannot get free. Return not later than 4 p.m. and settle into your hide, taking with you a raincoat, field glasses, waterbottle, and a thick rubber cushion—if likely to be troubled with a cough, take some lozenges too. Load your rifle and place it in a convenient position inside the hide. If the muzzle projects, a glint of sunlight off it may give you away. Then and not till then, have the goats brought up and one tethered to the peg with a thin but stout cord, if necessary doubled. English sash cord is best but seldom obtainable nowadays. It should be tied low down round the goat's fore leg leaving about 12 inches between peg and leg. It is not advisable to tie the rope round the goat's neck as the panther will want to seize it there and may be put off. As your men withdraw with the second goat to a pre-arranged spot about 300 yards away, they should call loudly to the tethered goat, which will almost certainly start bleating at once. If you can arrange for a flock of goats to be driven up and one tied up as they pass, so much the better, but this is seldom possible. The stage is now set and the result will depend very largely on yourself. You must keep as motionless as you possibly can, and only take an occasional peep through the blinded loophole to see that the goat has not broken loose, or in case he shows signs of alarm. Listen for warning sounds from monkeys, peafowl, small birds or squirrels; you may be able to get a shot before the panther rushes the goat. When that happens you will be in no doubt, as the rush is quite unmistakable, but sometimes a panther will work up close enough to seize the goat without much noise. No smoking of course, for reasons already given when dealing with shooting from a machan, which apply with even greater force to a hide on the ground, when the panther may be within a few yards. If for any reason it becomes necessary to change the goat, call up your men by whistle; a panther does not mind that, whereas shouting would definitely alarm him if within hearing, which may be the case. Keep under cover when the men come up, so as not to give the show away either to the goat or to the panther. If the peg draws or the cord

breaks when the panther rushes the goat, follow up cautiously and you will probably get a shot before you have gone 50 yards—this has happened to me on two occasions. If a shot from the hide has knocked the panther over, fire again if he shows the least sign of life; an animal which cannot raise its head from the ground is generally finished, but if you have taken the head-shot he may be only stunned, so don't take any chances. If he has rushed away after the shot, as so often happens, wait a little before following up; there will probably be a good blood trail which your men will puzzle out while you keep ready to shoot—your position being of course in front. If the hour is late and the wounded animal has got into a dense thicket, it is far better to leave him till next morning. Locate him by ringing the spot and put a man up a tree or on a rock on the far side, then bombard the place with stones and if this produces no result follow the trail, keeping all together with yourself leading. A good dog is invaluable for this sort of work. Let us hope you will find the panther dead, but if he has sufficient life to charge, a 12-bore with buckshot will prove far handier than a rifle.

Occasionally it happens that after you have settled into your hide the shikari returns with news that the panther has just been seen some little distance away and out of hearing of the goat's call. In such a case it is better to abandon your hide, hurry at once to the new spot with your goat, and take up a fresh position. There will be no time to make a hide. Get behind a good thick bush and lie down flat till you hear the rush, then rise cautiously and take your shot standing—it is an advantage if there is a tree (even a small one) both to rest your rifle against and to give you some cover as you stand up.

How long should one sit up in a hide on the ground? Personally, I come away as soon as it is too dark to see the sights. The loophole has got to be very large indeed to accommodate both rifle and torch, and is almost sure to be spotted, while the same objection applies to an electric lamp fixed outside the hide. You may of course use a 12-bore and buckshot after dark but my experience with this has been unfortunate.

On checking over the above, I find that I have said nothing about clothing. In my experience the best is a green bush-shirt (XIVth Army pattern) with long sleeves which can be rolled down if insects are troublesome, and green trousers or breeches. I am a great believer in shorts for normal shikar purposes, but they are definitely unsuitable for sitting up (either in a machan or a hide), as mosquitoes and ants keep one fidgetting, and immobility becomes impossible. For footwear nothing can beat soft hide boots with crepe-rubber soles. Short ankle putties should connect slacks and boots to prevent ants etc. exploring inside the former. For headwear use a soft hat which will not make a noise brushing against a leaf as a topi does.

Chance-met Panthers

Since panthers are so much more numerous than tigers, one would expect to come across them more frequently by chance, but

relatively I have not found this to be the case, to any marked degree. Their smaller size affords them better opportunities of escaping observation, and the way in which a panther can sink down and become almost invisible in grass not 6 inches high has to be seen to be believed. However, in the course of many years wandering in the jungle I have met quite a number, and have extracted from my diaries the more interesting of these episodes.

I was in camp in the Sirpur block of the Raipur district in March 1910, and as I was tying up for tiger, could use only the .22 to secure birds for the pot. On the 24th morning after finding my baits untouched, I went over to a tank close by and with a lucky shot bagged 2 whistling teal. Then, seeing some duck on the far side, I went round to stalk them, and literally walked on top of a fine male panther in the long grass—his tail went up almost in my face. He bolted 50 yards then stood and looked at us, and I was sorely tempted to try a shot at his brain, as I knew the sighting of the little .22 bore rifle to an inch, but there *are* limits, and I thought I should do better to sit up that evening. We found close by the remains of a chital doe killed 2 days before, so I had a machan put up in a tree but the goat refused to call, so nothing came of it.

I had an extraordinary experience with two panthers at Anaikatti on 6th May 1937. I had left the forest bungalow as usual before dawn making for a big rock about a mile distant across the river, which overlooks a favourite wild dog run. The Onion Rock, as it is called, is only about 8 feet high on the uphill side, and as we approached it in the faint light I could just make out a panther spread-eagled on the sloping side of the rock with tail up and head down, very like a mounted skin on the wall. It was only a few yards distant and drew our attention by growling at us. As we backed away some yards uphill my shikari Kunmada, whispered that there was a female at the foot of the rock, but hidden by some small boulders between. As soon as I could get a clear shot over the bushes, though my sights were still indistinct, I fired between his shoulders, and both panthers bolted in different directions. There was no blood, but by the bullet mark on the rock were some pieces of fur. How I missed at such close range I cannot to this day imagine but evidently I had. 'All hits are history—all misses mystery' was only too true in this case—but at least it was an unforgettable experience. Obviously I had interrupted a couple mating, and was lucky not to have been charged.

An unusual occurrence at Mudumalai on the 25th April 1940 also deserves mention. I had gone some way down the Benne road before dawn and branched off at the 4th mile while my driver George went on towards Pipagadi, a sure find for jungle sheep and pig. I heard him fire 3 shots, and at 9.30 a.m. he returned and told me that he had come across a panther stalking a chital doe at close range, and had fired at it, breaking both front legs as it crouched on seeing him. It fell over and then rushed into some long grass, and he had 2 more shots of which one certainly hit. I ran the car down to the spot and by working round managed to get a shot in which finished it—an old male with 3 broken teeth

and very lanky, and with only half a tail. And now comes the interesting part. In addition to the bullet wounds, I found a number of deep gashes, and the man whom G. had left up a tree to watch the spot, said that a boar had come across the wounded animal and had attacked it, charging 3 or 4 times. The panther was too badly hit to retaliate, and only growled in answer to the boar's grunts and onset, and the latter, presumably realising that he was finished then left him. The man up the tree thought it great fun, and never considered that the skin was being spoilt!

One final episode will close this section. In May 1941 I had to run up from Bangalore to Ootacamund to attend a conference, and managed to obtain a few days' leave, which I spent at Anaikatti. On the 21st morning I went about 2 miles towards the east, and took up my position on a spur looking south, across a deep ravine with a parallel ridge opposite. About 7 a.m. a herd of 19 elephants coming from my left passed in front of me, between the far edge of the ravine and the opposite ridge—they were about 300 yards away, and as they moved along feeding, made an interesting spectacle. Among them was a tiny calf which cannot have been more than a few days old, with a cow in attendance on each side. About 7.20 a.m. I suddenly saw a large panther coming at a fast walk along the far edge of the ravine in the opposite direction—he looked pale grey so long as he was end on to the sun, but when he turned half away all his lovely coat showed up. Suddenly he heard the elephants, which were quite close to him but out of sight owing to the slope of the ground. In a bound he was into the shade of a large bush, where he was difficult to pick up even with glasses though less than 300 yards away. He half crouched, then peered round in different directions, and finally went off after the elephants. The trackers said he was after the small calf, but I think it is more likely that he was simply curious about the noise. Anyhow a couple of minutes later he re-appeared, still at a fast walk, and after going some way down the path by which the elephants had come, turned up to his right over the ridge. I knew there were some large rocks projecting from it on the far side, and hoped that he might lie up on one, so after waiting 10 minutes, crossed the ravine and followed him. Topping the ridge, Kunmada who was leading drew back, and then I saw the panther lying on a ledge about 70 yards away—only part of him showed, but from the colour I guessed it to be a bit of the shoulder and the back of his head. A closer approach was impossible so I sat down and fired at the very small target which offered, and saw his tail flick up twice so knew that all was well. By moving a few yards to the right I could make out a patch of black and white stomach fur between the rocks, but he was lying on a ledge 10 feet from the ground, so first we went round by the left to the top of the ridge and from above with difficulty made him out through the branches of an overhanging tree. Access that way proved impossible, and so we had to retrace our steps and climb up from below to get him down—a fine old male with a deep orange coat, but only 6 feet 10½ inches in length, as his tail had lost about 6 inches. The bullet had caught him nicely on the shoulder and was found

inside the brain pan. I always remember this episode with satisfaction, as it was my own idea that he would lie up on the rocks—the trackers thought he would pass on. The shot I admit was a lucky one!

Panthers up Trees

In heavy forest, more especially where the grass is long, panthers not infrequently ascend trees, no doubt to locate deer or pigs with a view to stalking them. In the Mudumalai forest more than one has been accounted for in this position, but although I can recall at least four up trees, I have never been able to get a shot—they have been far too quick for me. I remember one occasion in particular—it was during May 1938, when I was on my way back from Doddakatte to Mudumalai. After topping the rise near Karadibetta, we turned down into the big swamp, and shortly after came to a partially burnt area. There was a herd of chital with several stags feeding out in the open, and I was moving towards them under cover of the trees, when a movement caught my eye in a well-leafed sloping teak tree which we were just about to pass. I looked up and saw a fine male panther cautiously descending, the sunlight through the leaves making him look green and brown. There was a quiet concentrated look on his face and he showed no hurry or alarm, but when I took the rifle from my shikari, he jumped down and galloped off, his tucked up hindquarters looking very small for such a big animal. In the open I might have got him, but a few bounds took him into long grass and though I could have got a snap-shot I did not fire, as my experience is that in such cases one generally breaks a hind leg and loses the animal. What may be called a fundamental shot, or a bullet at the base of the skull, will of course in such cases prove fatal, but one cannot be certain of either without a steady aim, and personally I prefer to forego a shot rather than risk losing a wounded animal. I have seen tiger and boar with one leg missing as the result of misplaced bullets. The wounds had healed wonderfully and were nicely rounded off, but how few animals can recover in such cases, compared with those which die a lingering death? Incidently the tree up which I saw this panther was a very low one, and sloped at an angle of about 60° for the first 10 feet and then flattened out still more.

Panthers and Hyenas

The hyena is generally considered to be a cowardly brute, but the fact remains that if one discovers a panther's kill, it will keep the rightful owner off until it has eaten its full. I have known this to happen on a number of occasions at Anaikatti, where hyenas are particularly common, and in not a single instance has the panther made any attempt to assert its rights beyond growling. The reason for this is not clear. Possibly the panther realises the immense strength of a hyena's jaws and fears being maimed in a rough and tumble, but that would imply reasoning as apart from instinct, a subject on which opinions differ. However, the fact remains that so long as the hyena is on the kill, the panther

will not come out to it, but will wait till the former leaves. A cartridge thrown at the hyena will sometimes drive it away, as the human scent will make it suspicious, but if that fails, I think the only thing to do is to emulate the panther's patience and wait till the hyena leaves of its own accord. If the hyena is shot, the panther certainly will not approach the kill so long as the carcase is lying there, and any attempt to remove it will almost certainly give the sportsman away.

While on the subject, I see from my Anaikatti diary of 1939, that a fine old boar came one night to a panther's kill (a large cow) and kept two hyenas off while he ate—he certainly suffered from no inferiority complex! He bolted as soon as the light was put on, as pigs invariably do in my experience, and then no less than four hyenas appeared and were at the kill till 5.30 a.m., taking pieces away and then returning for more. Needless to say, the panther did not materialise, but it was an interesting experience.

Stalking Panthers

If one has sat up overnight without success, it sometimes pays to stalk the kill at dawn. Just before the last war a couple of panthers killed a pony at the top of the Sigur ghat, only 300 yards from my bungalow, so I had a hide made in the bushes fringing the road and put a friend in it that evening. It was not a very hopeful place as there was a certain amount of traffic along the road, and the panthers, to reach the kill, had to come some way down the open hillside. A goat tied up near the shola where the panthers were presumably lying up would have offered better chances of success, but the shola in question was a sanctuary and closed to all shooting. As I feared, the panthers did not come before dusk so B. had to give it up. However he came out again next morning before dawn, and advancing very cautiously under cover, found both panthers on the kill; but by the time there was light enough for him to see his sights the panthers had gone. It was bad luck that the spot was so open as otherwise he would certainly have got a shot.

An example of stalking a panther on rocks has already been given, but in my experience this form of shooting is seldom successful. A panther lying down offers an extremely small target, while any attempt to rouse him merely results in his vanishing before a shot can be fired. If one can work round and above him, the shot will be far more likely to kill him outright, but this is seldom possible.

It is always worth while investigating when one hears monkeys cursing in the jungle—it may be at wild dogs, in which case a shot is pretty certain, but more likely a panther is the cause. I must confess that in the latter case I have never got a shot—the panther has always spotted me first—still it's well worth trying. When I was down at Anaikatti in August 1947 a panther hanging round the bungalow gave me an interesting experience but no shot. On the first morning we were on our way back from a long round, when near the Onion Rock I heard a rush about 70 yards

away, followed by a throaty growling and the furious barking of about a dozen chital—obviously a panther had tried to seize one but failed. It was open scrub jungle with a lot of small bushes and I hoped for a shot, but in spite of a most cautious approach failed even to see the panther. That evening sambar belling by the river showed that she was still in the vicinity, and next morning I heard monkeys cursing from a tamarind tree in thick lantana. With my shikari Banta I made a very careful stalk but could find nothing, and as the monkeys were now silent thought that the panther had gone. I sat down and had a cigarette and when we moved on a few minutes later the panther rushed away with growls—it had been lying within 20 yards of us all the time. On reaching the bungalow the waterman told me that he had met her that morning on his way to the well and that she was obviously 'expecting'—this no doubt was the cause of her reluctance to move and her previous failure with the chital. Her cubs were born a day later so I was glad that I had not the opportunity of a shot. What lesson is there in this episode? None! It is simply a jungle memory.

Black Panthers

Living as they do in much denser jungle than is favoured by the normal type, black panthers are by nature game killers, and so are seldom shot over a kill. Out of those which I have known to be bagged in the Nilgiris during the past 24 years only one met his fate when returning to a bullock which he had killed near Avalanche, from a dose of buckshot fired from a Badaga hut. This was a very fine old male which many sportsman had tried for over a period of years—14 to my certain knowledge and possibly longer. But as a rule black panthers are met by chance, and since they are so uncommon, luck plays a very large part. The only black panther which I have seen myself was some 8 miles down the Benne road from Mudumalai 2 years ago. As we turned a corner one morning my shikari Masty who was leading suddenly halted and backed, literally speechless with excitement. I peered round a tree and saw a black panther crossing the forest road 160 yards away, so sat down quickly and fired at her shoulder. I thought I knew the sighting of my .318 to an inch, and made allowance for the fact that the cartridges were shooting high—they were pre-war, and incidently I have not even yet (1948) been able to get fresh ones! However the bullet must have gone over, as she turned and sprang into the long grass, and when we examined the spot there was no sign of blood or extended claw-marks. So that was that! My single chance spoilt by faulty ammunition.

But my driver George has been more fortunate. In June 1939 I sent him down to Mudumalai with a friend who was keen but had little experience of shikar. On their first morning C. had a shot at a nice chital stag but missed. The herd went down towards the swamp, so C. followed but could not get another chance as the stag was hidden by the does. Suddenly the deer began to bark and shortly after a cry showed that one had been seized by a feline. Approaching with great caution through the long grass

they saw in a small nullah part of a stag and the hindquarters of a black panther on it, only 10 feet away. While they were peering over a fallen tree to get a better view it spotted them and bolted—both fired but missed. A machan was put up and they sat up all night but it never returned, rather naturally, since it had been fired at over the kill. George saw another black panther, a good deal smaller than C.'s the same year down the Benne road while waiting for me—it passed not far from the car and went in the direction which I had taken an hour before, but we did not meet. On another occasion he saw the big male previously mentioned, at the top of the Avalanche pass, but too far for a shot. Finally he shot a female at Avalanche, and since it was a good example of what may be called the luck element in shikar, I will give the details.

We knew that this particular animal was in the habit of lying out on a small cliff at the head of the Avalanche river, where indeed one had been shot some years before, and I spent the first two days watching the spot, but without success. The third morning proved equally fruitless, but while sitting there we heard a tiger roaring far uphill on our left and shortly after caught sight of him moving towards the head of the Lakkidi pass. It was then too late to do anything about it, but in the afternoon I went up the hill hoping to find him on the move again before dusk—my luck was however out. In the meantime I sent George upstream to shoot a hind sambar for the fish hatchery, and he fired at two but missed. Shortly after he topped the low ridge from which I had been spying previously, and saw a black panther about 200 yards away walking across the open between two sholas. He fired and broke its back—a lucky shot, as if the bullet had been an inch higher it would have missed. I must confess that my congratulations were not untinged with envy!

Clouded Panther

Quite a number of skins of the Clouded Leopard (as it is more generally termed) used to be brought into Bhamo by Kachin shikaries in the old days before the 1st World War, and no doubt they are still to be found in the dense forests covering those hills. I was always hoping to come across one, during my jungle outings from Bhamo, but never had the luck to do so. The large irregular markings make the skin an especially handsome trophy—finer in my opinion than that of the black panther. Among a number which I have handled I found two distinct types—one with the background greenish, and the other a dull brown shade.

Conclusion

This series of panther episodes has proved a good deal longer than I had anticipated, in spite of the fact that I have described only those of special interest, or indicative of methods to be adopted in dealing with this cunning animal. The very full details I have given regarding sitting up will, I hope, prove useful to others, more especially to young sportsmen, and save them wasting time and money.

If I were asked which of my panther memories is most vivid, I should find it hard to answer. The one finished off by lamp light at Raipur?, 'Old Sala' sitting by the dead goat with his ears laid back and scrutinising every bush? The spread-eagle on the Onion Rock? The shot which stopped the blind rush at Ghatkesara? The pair which rushed the goat together? The one so carefully descending the tree at Mudumalai? The one which stalked the elephants and was himself stalked in turn? Besides these there are others which I have not related: the three seen stalking a sambar calf far below from the top of Avalanche hill, while the hind kept them off; and the belated reveller escorted across a grass maidan at Doddakatte in broad daylight by a barking semi-circle of some 60 spotted deer. All these are clear on the screen of memory, but I think I must give pride of place to my first panther, as she came out of the bushes at full stretch after the Bhil, with the arrow swaying in her flank. That is a memory which can never fade.

Which of my panthers has given me most satisfaction? That is easier to answer, because I can honestly say that those which I 'introduced' to friends, have given me more pleasure than all the rest of my own put together.

One final point. I have often wondered why no enterprising zoologist has counted a panther's spots, and created subspecies from the result. Most people know the story of the showman at the circus, who assured the old lady that a panther has 365 spots, 'one for every day of the year', and what his reply was when asked where the spot for leap-year was situated! But seriously, has no one ever tried to count a panther's spots? Here is a problem still awaiting solution!

(To be continued)

NOTES ON THE GESNERIACEAE OF BOMBAY

BY

H. SANTAPAU, S.J., F.L.S.

Key to the Gesneriaceae of Bombay (after Cooke and others) :

Seeds with a long hair at each end ; epiphytic shrubby plants : 1. *Aeschynanthus.*

Seeds not tipped with long hairs ; ground plants :

Inflorescence cymose, axillary or terminal :

Pedicels adnate to the petioles ... 2. *Didymocarpus.*

Pedicels not adnate to the petioles :

Small, erect herbs with leaves nearly as broad as long ; stamens 2 ... 3. *Epithema.*

Small undershrubs with stoutish stem ; leaves oblanceolate, much longer than broad ; stamens 4 perfect ... 4. *Isanthera.*

Inflorescence in elongated racemes :

Stamens 4 ; calyx winged, one wing often much larger than the rest ... 5. *Klugia.*

Stamens 2 ; calyx not at all, or at least not prominently winged, all the wings, when present, being about equal ... 6. *Rhynchoglossum.*

1. AESCHYNANTHUS Jack

The name *Aeschynanthus* was first published by Jack in Trans. Linn. Soc. 14 : 42, t. 2, f. 3, 1823, and is one year later than *Trichosporum* D. Don in Edinburgh Phil. Journ. 7 : 84, 1822. The name *Aeschynanthus*, however, is included in the list of *nomina conservanda* in the 1947 edit. of the Intern. Rules of Botanical Nomenclature.

1. *Aeschynanthus Perrottetii* A. DC. in DC. Prodr. 9 : 261, 1845 ; C. B. Clarke in DC. Monogr. Phan. 5(1) : 25, 1883 ; id. in Hook. f., Fl. Brit. Ind. 4 : 339 1884 ; Dalz. & Gibs., Bomb. Fl., 135 ; Cooke, 2 : 321 ; Gamble, Fl. Madr. 985.
   Aeschynanthus grandiflorus Graham, Cat. 146, 1839 (non Spreng.)
   Trichosporum Perrottetii (A. DC.) O. Kuntze in Rev. Gen. Plant., 1891.

The habit and leaves of this plant are very similar to those of some of the Hoyas of Bombay, for which it might easily be taken. The corolla is long, tubular, somewhat curved, the colour being red or scarlet. The fruit is a long capsule, very similar to the follicles of the Apocynaceae or Asclepiadaceae. Among the plants in Kew Herbarium there is a specimen labelled by Dalzell as '*Hoya pauciflora* R. W.', the identification of which has been corrected by C. B. Clarke to '*Aeschynanthus Perrottetii* A. DC. var. *malabarica* C. B. Clarke' ; another specimen, Ritchie 1861, is also labelled as *Hoya*, but here the mistake is easily understandable as the specimen is in fruit and looks remarkably like *Hoya Wightii* Hook. f. The seeds of *Aeschynanthus Perrottetii* are typical, as they are very minute and possess one very long hair at each end.

2. *Aeschynanthus Perrottetii* A. DC. var. *planiculmis* C. B. Clarke in DC. Monogr. Phan. 5(1) : 26, 1883 ; id. in Hook. f., Fl. Brit. Ind. 4 : 340 (*platyculmis*).
   Aeschynanthus planiculmis Gamble, Fl. Madr. 985, 1924.
   Aeschynanthus ceylanica Wight, Icon. t. 1347 (non Gardn.)

Clarke in the original description of this variety, gives the following characters : branches compressed ; leaves densely approximate, broadly lanceolate

or elliptic, narrowed at both ends ; umbels 2-4-flowered ; corolla 35-40 mm. long. Gamble, loc. cit., raised this variety to the rank of a species, and gave as the distinguishing features of the plant its flattened stems and its very broadly ovate leaves. Cooke, p. 322, seems inclined to deny recognition to Clarke's variety, as he explains the flattening of the stems as due to the epiphytic character of the plant.

Among the specimens at Kew, there are a few with very markedly broad leaves, whilst others, said to be the typical species by Clarke, have narrow oblong leaves. Moreover, there seems to be a continuous set of intermediate stages between the broad and the narrow leaved specimens, sometimes both types of leaves appearing on one and the same specimen. In my opinion, there is very little ground for erecting the broad-leaved plants into a variety, much less so for erecting them into a species.

When Clarke first published the name of his variety in 1883, he called it *planiculmis*, and the publication being valid, the name must stand as a legitimate one. In 1884, Fl. Brit. Ind. 4 : 340, the name appeared changed into *platyculmis* ; moreover, in Kew Herbarium there are numerous sheets with this amended spelling written in Clarke's own handwriting ; this shows that Clarke intended the name to be *platyculmis* and not *planiculmis*. It is quite possible that De Candolle introduced the correction into Clarke's MS before publication in the DC. Monogr. Phan., the hybrid name *platyculmis* being considered offensive to the ears of a good Latin scholar. Be that as it may, the name was actually and validly published as *planiculmis* and this is the spelling that has to be retained.

2. Didymocarpus Wall.

The generic name *Didymocarpus* Wall. in Edinb. Phil. Journ, 1 : 378, 1819 is *nomen conservandum* against *Roettlera* Vahl. Enum., 1 : 87, 1805.

1. *Didymocarpus hamosa* Wall., Cat. no. 788, 1829, *nom. nud.*
   Chirita hamosa (Wall.) R. Br. in Benn. Pl. Jav. Rar. 117, 1840 ; Clarke. in Comm. et Cyrt. Beng. 110, t. 78, 1874 ; id. in. DC. Monogr. Phan 5(1) : 128, 1883 ; id. in Hook. f.. Fl. Brit. Ind. 1 : 360, 1884 ; Cooke 2 : 322.
   Didymocarpus cristata Dalz. in Hook. Kew Journ. Bot. 3 ; 225, 1851 ; Dalz. & Gibs., Bomb. Fl. 134.
   Roettlera hamosa (Wall.) O. Kuntze, Rev. Gen. Pl. 415, 1891 ; Fritsch in Engler, Pflanzenfam. 4(3b) : 148, 1895.

Wallich published the name of *Didymocarpus hamosa* in his Catalogue or List, but in the absence of a description, the publication was not valid ; the plant was first described by R. Brown under the name of *Chirita hamosa*, the name *Didymocarpus hamosa* Wall. being cited as a synonym by Brown, the date 1840 must therefore be considered as the earliest date for the valid publication of *Chirita hamosa* as well as *Didymocarpus hamosa*.

When this plant is in its vegetatives stages, i.e., in full foliage, it is very similar to *Klugia notoniana* or *Rhynchoglossum obliquum*, its leaves are very oblique, and of about the same size as those of the two plants just mentioned. The most typical part of the plant is that the pedicels of the flowers and fruits are adnate to the petiole of the leaves, in the axil of which they are produced. After the decay of the leaves, the plant presents a very strange appearance.

3. Klugia Schlecht.

1. *Klugia notoniana* (Wall.) A. DC. Prodr. 9 : 276, 1845 ; Wight, Icon. t. 1353, and Illustr. t, 159 bis ; Bot. Mag. t., 4620 ; C. B. Clarke, in DC. Monogr. Phan. 5(1) : 159, 1883 ; id. in Hook. f., Fl. Brit. Ind. 4 : 366, 1884 ; Fritsch in Engl. Pflanzenfam. 4(3b) : 155. f. 71, 1895 : Cooke, 2 : 323.
   Wulfenia notoniana Wall., Tent. Fl. Nep. 16, 1826 ; id. in Cat. 409.
   Rhynchoglossum scabrum Dalz. in Kew Journ. Bot. 2 : 140, 1850.
   Klugia scabra Dalz. and Gibs., Bomb. Fl. 134.
   Klugia notoniana var. *scabra* C. B. Clarke, in Kew Herb.

When this plant is neither in flower nor in fruit, it is not possible to separate it from *Rhynchoglossum obliquum* or its variety *parviflora*. When in

flower it is quite easy, as its flowers are considerably larger than those of *Rhynchoglossum*; its calyx, moreover, is 5-winged, one of the wings being considerably larger than the rest, at least on many occasions, and even when the wings are equal they are much larger than those of *Rhynchoglossum*.

This seems to be a relatively rare plant in Bombay: it is only towards the south of the Presidency that it becomes tolerably common.

4. Rhynchoglossum Blume

1. *Rhynchoglossum obliquum* Blume, Bijdr. 741, 1826; Clarke in DC. Monogr. Phan. 5(1): 161, 1883.
   Rhynchoglossum Blumei DC. Prodr. 9: 274, 1845.
   Wulfenia intermedia Wall. Cat. 408, 1829.
   Loxotis intermedia Benth., Scroph. Ind. 57, 1835.

This is the typical variety, and does not occur in Western India; it is the commoner variety in Burma, Java, Sumatra. This species is very similar in most respects to *Klugia notoniana* A.DC., from which it differs mainly in having only two stamens and a plain, not-winged calyx.

2. *Rhynchoglossum obliquum* Blume, var. *parviflora* C. B. Clarke in DC. Monogr. Phan. 5(1): 163, 1883; id. in Hook. f., Fl. Brit. Ind. 1: 367, 1884; Cooke, 2: 324.
   Rhynchoglossum obliquum DC. Prodr. 9: 274. 1845; Wight, Illustr. t. 159 bis, f. 7; C. B. Clarke, Comm. et Cyrt. Beng., t. 88, 1874 (non Blume).
   Rhynchoglossum zeylanicum Hook. Bot. Mag. t. 4198.
   Rhynchoglossum Rheedei DC. Prodr. 9: 274, 1845.
   Wulfenia obliqua Wall., Tent. Fl. Nep. 45, t. 35, 1826; id. in Cat. 407, 1829.

This is much the commoner form in Western India; Clarke in DC. Monogr. Phan., loc. cit., states that this plant is found in valleys in subtropical districts almost everywhere, and that it is about the most widely spread among the plants belonging to this family.

This variety differs from the typical variety in having its calyx teeth very acuminate, and the inferior corolla lip narrower than and about twice as long as the superior lip. In general, flowers of the variety are smaller than those of the typical plant. Many of the plants which I have collected in Khandala on the Western Ghauts show the remarkable arrangement of the inflorescence which was mentioned in the case of *Didymocarpus*, that is to say, the inflorescence is adnate to the petioles, and there may be as many as four or five racemes arranged in a row along the petiole of a single leaf.

R. obliquum var. *parviflora* is a very common plant along the Western Ghauts; it is generally found on rocky ground, occasionally on trees or on old walls; the leaves are very thin and hence rather difficult properly to preserve in herbarium specimens, unless special care is taken in the pressing process.

5. Epithema Blume

1. *Epithema carnosum* Benth., Scroph. Ind. 57, 1835; Clarke in DC. Monogr. Phan. 5 (1): 177, 1883.
   Aikina carnosa G. Don. Syst. 4: 665, 1837–1838.
   This is an East Himalayan plant, not found in Western India.

2. *Epithema carnosum* Benth., var. *hispida* C. B. Clarke, in DC. Monogr. Phan. loc. cit. 178; id. in Hook. f., Fl. Brit. Ind. 4: 369, 1884; Cooke, 2: 325.
   Epithema hispidum Wight, MS. in Herb. Kew.
   Epithema pusilla C. B. Clarke MS. in Herb. Kew.
   Epithema zeylanicum Wight, Illustr. 159, f. 3; it. Icon., y. 1354.

This variety, as indicated by the name, differs from the typical plant in having hispid leaves and peduncles. It seems to be a fairly rare plant in Bombay, except in the Southern districts of the Presidency, where it is tolerably common. The variety *pusilla* Clarke appears to be but a young specimen of var. *hispida*.

6. ISANTHERA Nees

1. *Isanthera permollis* Nees in Trans. Linn. Soc. 17 : 82, 1834 ; DC. Prodr. 9 : 279, 1845 ; Wight, Icon. t. 1355; Clarke in Hook. f., Fl. Brit. Ind. 4 : 372, 1884: Fritsch in Engl. Pflanzenfam. 4 (3b) : 159, 1895 ; Santapau in Journ. Bomb. Nat. Hist. Soc. 46 : 380, 1946.

For a full description of this plant, see the last reference, where I gave the plant as a new record for the Presidency of Bombay. The shape of the leaves and the habit of the plant is quite distinct from the rest of the Gesneriaceae of Bombay. It seems to be a fairly common plant in Southern India; but as for Bombay, I have only seen the specimens mentioned in my paper in this *Journal.*

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THE GIR FOREST AND ITS LIONS

BY

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(With a sketch map)

I

The Gir Forest has been so strictly preserved that for many years it has been a *terra incognita* except to the very few. The only authoritative articles written on it and its lions appeared in the Bombay Natural History Society's *Journal* as long ago as 1909 and 1911, and in these their author, Colonel Fenton, wrote of a period towards the end of the last century. Since then, except for a short article in 1935 based largely on those of Colonel Fenton, no news seems to have escaped from behind the iron curtain, as it were, and the world at large has remained in profound ignorance about the fate of the Gir lions.

In consequence it was with very considerable interest that I undertook, on behalf of the Bombay Natural History Society, to visit the forest and find out all I could about them and their preservation.

The Regional Commissioner, the Administrator, and the Chief Forest Officer were all most co-operative, with the result that I was given every help in the way of transport and accommodation, and *carte blanche* to find out all I could.

My original plan was to cover the whole area in one tour, but six inches of most unseasonable rain fell the night before I was due to leave for the forest and rendered all roads impassable, so that I had to be content to go to Sasan by train and restrict my investigations to that neighbourhood, covering it on foot and by pony. In the end this turned out to my advantage as I had to pay a second visit to the forest in December, during which I explored the Jamwala and Jasadhar divisions very thoroughly by car, and so was able to complete my programme much more fully than I originally had expected.

* * * * *

In days gone by lions inhabited suitable parts of all north and central India, and even until the beginning of the last century were still common in many parts of this area. In 1822 they were yet to be found in considerable numbers near Saharanpur and Ludhiana, and they were also known in northern Rohilkhand and about Moradabad and Rampur. In 1831 a writer stated that they had been very numerous in Harriana until a few years previously, though they were unknown at the time of writing. However, they were recorded up to 1847 in the Sagar and Narbada territory, one was killed at the 80th mile from Allahabad on the Jubbulpore railway in 1866, and they lingered on much later in Gujerat and Central India.

In the 1830's they were by no means scarce on the banks of the Sabarmati river, and round Mount Abu, Ahmedabad and Deesa. It is recorded that they were hunted on horseback in the last locality by British officers in 1832. The method adopted is not known but no doubt it differed from that employed by John Nicholson when hunting tigers near Rawalpindi some years later. Having found his tiger, he would gallop around it in ever decreasing circles until the beast became dizzy and he was able to ride in and finish it with his sword.

The last lion to be killed in Gujerat was shot at Deesa in 1870.

In Central India they existed even later, one being killed in 1873 and one being seen as late as 1884, but the latter was the last record of any lion outside Kathiawar.

In Kathiawar lions were to be found in Dhrangadhra, parts of Jasdan, Chotila and the jungle tract that ran uninterrupted from the eastern Gir through Girnar[1] to the Alech and Barda Hills in the west. Later they disappeared from northern and central Kathiawar and this jungle tract became their solitary home. With the gradual settlement of the country much of the jungle was destroyed and, when the areas mentioned above became separated from one another by cultivation, the lions finally retired to the protection of the Gir Forest, though as late as the end of the last century parties of them would find their way as far afield as the Barda Hills. Even to this day they sometimes turn up in the Girnar.

It is unnecessary to look far for the cause of their extinction in other parts of India because their fearlessness of man and liking for fairly open country has always made them an easy mark for sportsmen and others.

As for the Gir lions themselves, Colonel Fenton, writing about the forest as he knew it towards the end of the last century, painted a gloomy picture of their future. Such was the poaching and uncontrolled shooting of them that he foretold their speedy extinction (the which he did his little bit to bring about by killing four). That this prophesy had nearly been fulfilled was revealed by Mr. Wallinger, the Chief Forest Officer of Junagadh State, in 1913, after a tour of the forest lasting for nearly two months, when he reported that he thought that there were only from six to eight lions left and that there were certainly not more than twenty. Mr. Brooke-Fox, the Chief Engineer of the State, a keen shikari and one who knew the forest well, confirmed Wallinger's opinion.

As these were the considered statements of two responsible persons, it must be assumed that the lions were, at that time, on the very threshold of extinction.

As a result of this report, Mr. Rendall, the then Administrator, put a ban on the shooting of lions in Junagadh State and at the same time urged states adjacent to the Gir to do the same. Baroda State somewhat naïvely undertook to drive back any lions found within their limits!

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[1] Distinguish between Gir and Girnar. The latter is the mountain behind Junagadh, some 17 miles away from the Gir Forest.

At a later date, one imagines when the number of lions was thought to have increased, a limited quota (never more than three a year) was shot, and the present rules for their protection were imposed. These rules, in addition to the control on the number shot, *inter alia,* prohibited the shooting of lionesses and cubs, any other form of shooting in the forest without special permission, and shooting from any kind of vehicle.

All this was wonderfully successful and the number of lions increased to a remarkable extent.

A census was held in 1936 with the following results:—

Division	*Lioas*	*Lionesses*	*Cubs*	*Total*
Visavadar ...	19	7	5	31
Sasan ...	22	27	11	60
Talala ...	18	20	24	62
Jamwala ...	46	15	7	68
Jasadhar ...	38	22	6	66
Total ...	143	91	53	287

As this census was based on the counting of fresh pug marks at drinking places, and on the assumption that lions must drink once, but seldom more than once, in the twenty-four hours, it was held at the end of April when the dry weather had reduced the number of drinking places to a minimum. To prevent the counting of any lion more than once the pug marks were measured, length- and cross-ways, and their sex and direction of departure noted. A watch was also kept around the drinking places for two days previous to the count so that the enumerators should have a good knowledge of the tract allotted to them and some idea of what lions were about. Early on the day before the count all old marks were smoothed over, and the fresh ones were reckoned up the following morning.

This census covered some 700 square miles, including the four forest divisions of Sasan, Visavadar, Jamwala and Jasadhar with their environs, together with Talala Mahal, a region of mixed forest and cultivation which the lions inhabit just as freely as the forest itself. Within these areas the enumerators (who numbered 534) worked in batches each under the supervision of a pagi or some other suitable forest employée. The results were handed in for scrutiny and lions that were suspected of having entered the records more than once were eliminated.

At least this was how it was done in theory, and given a sufficient number of persons competent in junglecraft (and the forest seems well able to furnish these) such a census when undertaken conscientiously should produce a tolerably accurate result. But after making careful enquiries I discovered that certain enumerators, and probably supervisors, added non-existent lions to their totals, on the assumption that the more lions there were recorded, the more lion shikar there would be . . . with its attendant opportunities of baksheesh. So that, although I was assured that the

census was otherwise very carefully carried out, and that the number of lions so added was very small, the result is, to say the least, suspect.

Nevertheless, the census figures, accurate or not, together with the figures given below of lions shot and found dead in the eleven years following the census, are enough to prove that the protection policy had been a wonderful success, especially when it is remembered that a considerable proportion of those beasts which die in the forest will never be found, and some of those that are found will never be reported . . . especially if their skins are in fairly good condition !

1936 to 1947 (inclusive)	*Lions*	*Lionesses*	*Cubs*	*Total*
Shot ...	27	1	0	28
Found dead ...	18	27	4	49
Total ...	45	28	4	77

(It should perhaps be noted that the proportion of lions to lionesses is almost identical in both tables, viz. 1.57 and 1.6 to 1).

* * * * *

Indian and African lions seem to differ little either in habits or appearance nor is there any reason to think that they differ in size. According to the *Journal* the record Indian lion measured 9′ 7″ and the African 10′ 7″, but the Indian figure relates to the end of the last century since which time data have not been generally available. The Junagadh forest authorities have the record of a 10′ 6″ beast, but as they also have the record of a fabulous monster of just under 12 ft., this figure has to be accepted with a certain amount of reserve. However, it must be remembered that the Gir is but a tiny territory when compared with the haunts of the African lion and it would be most unlikely for it to produce any record-breaking animals. Average measurements compare very well with those of African lions.

The Indian lion is a more shaggy creature than the African, with a fuller coat and with a longer tuft of hair at the end of the tail and on the elbow joints, as well as a fuller fringe along the belly. In conjunction with these characteristics the lion's mane is scantier. Occasionally the mane is blackish, or interspersed with darker hairs.

The Gir lion is a gregarious creature and often travels about in parties (though this habit seems now to be less common than heretofore . . . probably because there are less lions) and hunting may be done in concert, some of the group separating a beast from the herd they are attacking and driving it towards the others which are waiting to kill it.

For food they will kill whatever is most easy to come by, and, as they show little fear of man and his dwellings, are in consequence inveterate killers of cattle and buffaloes, which, in fact, as kills of forest game are seldom found, seem to form much the larger part of what they eat. In all probability they were first driven

to this habit during one of the famine years which reduced the quantity of game in the forest, and the habit, once contracted, has continued even when game has increased. They are also prepared, on the one hand, to kill goats and camels, and, on the other, wild boars. They will not, however, attack a buffalo unless it is separated from the herd.

In the ordinary course of events they like to kill on alternate days, though when more than two or three lions are associated, one kill will not suffice them all and they will have to kill more often. They will not return to a kill the next evening.

Although they avoid human habitations by day they are remarkably fearless of man and will allow his near approach before sauntering off with dignity. They will attack him only under great provocation (though lionesses with cubs are to be avoided!) and man-eaters are unknown.

During the daytime they lie up at some waterhole or in the shade of a tree, especially a banyan, to come out at dusk to haunt the outskirts of a village or nes at the time when the cattle are driven home. Often the male spends much of the night roaring, for they are very noisy animals, especially when mating. The female is more silent. They may also travel a long way at night and can be found sleeping some miles away from where they have killed.

During those seasons when there is plenty of water outside the forest, from July to November, many lions leave the forest for its outskirts and the cultivated country nearby or even further afield. In Kathiawar it is almost universally believed that this is due to the lions' intense dislike of the swarms of mosquitoes that inhabit the forest during the wet weather. Although, after visiting the forest in October, December and January, I have still to see there a single mosquito, I shall nevertheless accept their presence, as the whole tract has a most unenviable reputation for malaria, but that they are in sufficient numbers to drive the lions from the forest I refuse to believe! The truth of the matter is, I think, that it is the nature of lions to wander, but when water becomes scarce outside they naturally return to the forest where they can easily find it throughout the year.

Concrete proof that lions do wander well away from the Gir during the wet season is furnished at the Junagadh zoo by two lionesses, one of which was caught nearby, whilst the other in actual fact encaged herself!

For several successive nights during September of last year (1948) a wild lioness was seen hanging around the cage of an African lion. She used to arrive after dark in a state of considerable excitement and try to enter his cage. At the first signs of dawn she would slip away to lie up in the neighbouring Girnar jungles.

It was decided to capture her. Two African lions, including the one of whom she was enamoured, were placed in two cages so that there was an empty cage between them. The gate of this was left open and a young goat, as an added attraction, was tied up inside it. These cages are very roomy enclosures out in the

open, each with a den attached in which the animal may lie hidden when it feels like it.

The lioness arrived soon after dark and with little hesitation walked into the middle cage, the gate of which was immediately shut so that she was imprisoned. She, however, was in such a state of excitement that she did not seem to notice this, nor did she pay any attention to the goat until by chance it got in the way of her frantic pacings up and down the side of her African friend's cage. She then, as far as could be seen, gave it a petulant blow that knocked it over but did little physical damage.

At this point a keeper slipped into the cage and rescued the goat. It is sad, but hardly surprising, to relate that the goat died of shock soon afterwards.

The lioness continued her pacings and efforts to reach her lover until daybreak, but as soon as people began to appear she became frenzied with fury and alarm (and perhaps frustrated passion) and hurled herself repeatedly at the bars of her cage until she collapsed in an exhausted state with the front of her head badly damaged.

As the sun rose higher and it became very hot she was urged (with the aid of small pebbles) to enter her den. This she did and the door was shut upon her.

Here she refused to eat for several days, but at the end of forty-eight hours made no objection to the application of boric ointment to her wound at the end of a long stick, and, indeed, afterwards seemed to appreciate it. After a day or two more she commenced to eat the food offered her (liver and kidneys) and soon began to recover.

When I saw her in December she looked fit and appeared to be becoming more or less reconciled to her fate.

Of other local beliefs perhaps the commonest relates to the lions' fear of snakes. These, they say, kill many lions . . . instantaneously, of course . . . and deaths from this cause rank second only to those caused by the digestive troubles of old age due to decayed teeth and the inability to chew bones properly. Put a twist of blackened rope across a path and lions will avoid it like the plague. Lions also avoid long grass for the same reason, but best of all is the story that after making a kill the lion looks at the twitching tail with suspicion, and, because it reminds him of a snake, tears it out by the roots and lays it aside at a safe distance before beginning his meal!

I only saw one snake and that was a green whip, or tree snake, a species hardly likely to kill a lion.

However, to leave fiction for fact, the lioness mates at the age of $2\frac{1}{2}$ to 3 years and usually produces two, less often three, four, or five, cubs at intervals of 18 months to two years. October and November are the chief mating months, presumably because the cubs will be born in January and February, the healthiest time of the year.

According to Prater, the life span of the lion is the same as that of the tiger, some 30 years.

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The Gir Forest is a hilly piece of country situated in southern Kathiawar, south-east of Junagadh city and perhaps 17 miles from it at its nearest point.

The Great Trignometrical Survey of 1878 gave its area as 1,200 square miles, but such has been its progressive destruction that it is now reduced to half its former extent, of which about 500 square miles are in Junagadh territory.

Much of the central, southern and western parts of the forest are thick, but on the northern side it quickly degenerates into scrub jungle before giving way to open country.

The eastern Gir is largely covered with a growth of Acacia, although there are thick patches of jungle along the rivers and nalas.

The Junagadh Reserved Forest is divided into four divisions, and the so-called sanctuary block of Devalia. There are also extensive patches of jungle in Talala Mahal, an additional strip in Baroda territory to the north, and about 40 square miles in the Jetpur block, which forms a wedge between the Sasan division and the Devalia sanctuary. This block, as will be seen later, has had at times an unfortunate effect on preservation within the Junagadh Gir.

At the end of the monsoon, the forest which is of what is known as the 'mixed deciduous type', presents a most attractive appearance, as the variety of plants and trees is great and it is then green and luxuriant. During the hot weather, when the trees have shed their leaves, it becomes a desolate wilderness.

The trees are somewhat stunted, possibly because rock is everywhere near to the surface, and the undergrowth is seldom dense so that the grazing of cattle and buffaloes can take place throughout much of the forest. Here and there are open grassy glades, and, near its edges, patches of cultivation. The forest itself is much cut up into nalas with rocky beds, and intersected by low ranges of small hills, the latter often being bare or only covered with a scanty growth of trees.

By far the commonest tree is teak, often disreputable in appearance owing to the depredations of the defoliator. After teak the most noticeable trees are perhaps *Wrightia tinctoria,* flame of the forest (*Butea frondosa*), an ebony (*Diospyros melanoxylon*), laurelwood (*Terminalia tomentosa*), ber (*Zizyphus jujuba*), *Sterculia urens* with its broad paper-white trunk and gnarled spreading branches, the graceful water-loving jambudo (*Eugenia jambolana*), karanj (*Pongamia glabra*), simul or silk-cotton (*Bombax malabaricum*), and a variety of Acacias of which the most numerous are *Acacia arabica* (babool), and *Acacia catechu,* though *Acacia suma, Acacia ferruginea, and Acacia leucophlaea* are all plentiful. Less common are *Adina cordifolia,* bael (*Aegle marmelos*), the Indian laburnum (*Cassia fistula*), *Phyllanthus emblica*, and *Bauhinia racemosa,* though none are rare and the last named is most abundant round Sasan. Here and there a pipal or banyan overtops all other trees, the latter, because there are no goats to nibble its pendent aerial rootlets, growing to a fine tree with the main and subsidiary trunks often covering many square yards of ground.

Of shrubs perhaps the twin-leaved *Gymnosporia montana, Holarrhena antidysenterica* (a name that must be hard to beat), and *Helicteres isora* are among the commonest, and of climbing plants, of which there are not many, *Acacia pennata, Zizyphus oenoplia,* and a plant with palmate leaves that they call the 'water creeper'.

Although in autumn and winter this forest has great charm, at no time can it have any professional attraction for the forester. A long tradition of lack of attention, uncontrolled fires, inefficient felling and harmful lopping of branches has combined to produce a forester's nightmare, a tangled wilderness of twisted, malformed, and mutilated trees.

(Here I must add in parenthesis that the forest is now under the control of an experienced officer.)

As the Gir Forest is the only forest of any extent in Kathiawar it is of considerable importance, not only for its forest products (which after all are of poor quality), charcoal, and firewood, but also for its effects on climate and the water table of the surrounding districts, and, above all, for its excellent grazing lands.

Very large numbers of cattle and buffaloes graze in the forest, and this year, in addition, some 20,000 head from the famine areas have been allowed to enter. Large quantities of fodder are also being exported to other parts of Kathiawar.

Some of the herds are owned by cultivators but the great majority belongs to professional graziers living in the forest villages, or nesses as they are named. These little settlements with their thatched wattle huts, each surrounded by a dense thorn enclosure within which the stock is kept at night, are quiet places and very much part of the forest. Their owners are mostly of the rabari caste, men of fine physique, dark golden-brown skins and dignified features, a race entirely different from any other found in Kathiawar. Like all the forest dwellers they are courteous and hospitable, free with their offers of food and drink. In the warm weather they go naked from the waist upwards and the fact that their bodies are uniformly well covered with flesh bears testimony to the quality of the milk that they consume in vast quantities.

The main products of the nesses are, obviously enough, butter and ghee.

The forester at Sasan, one Sher Mahommed (a remarkable fellow who knew the Latin name of almost every plant and tree in the forest and was a veritable encyclopaedia of their various uses), was my informant about local wild life. As well as lions there were, he said, 'tigers' (panthers), 'jungle sheep' (four-horned antelope)[1] and 'stags' (sambar), but when he told me that there were also 'blue beasts and spotted beasts' I thought for a moment that I had discovered that mythical land of heraldry inhabited by blue boars, red lions, unicorns, white harts, green men and the like after whose fauna so many English inns take their names. But to my chagrin it appeared after all that these were his names for nilgai and chital.[2]

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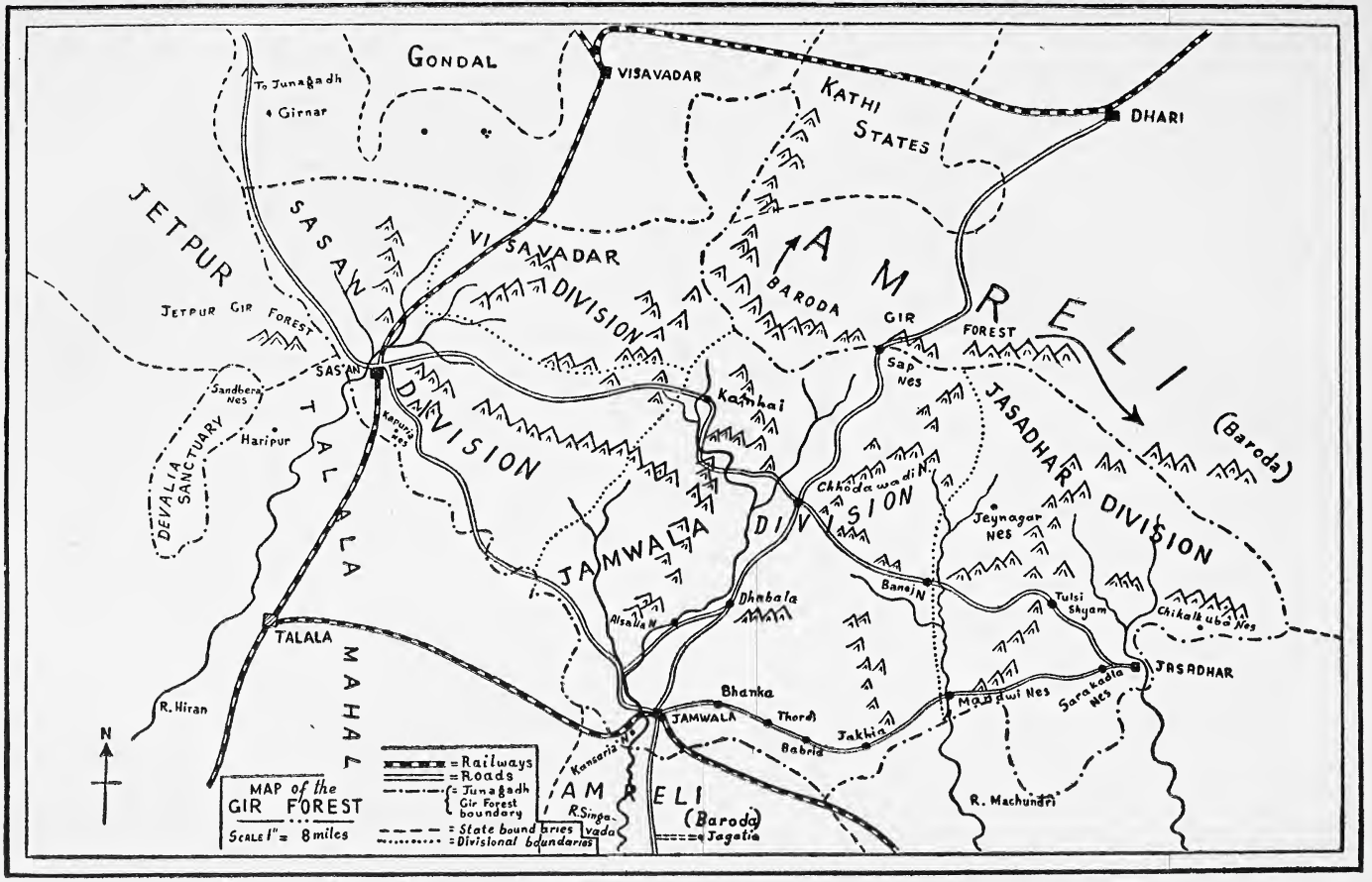
[1] Other areas are the 70 square miles of Girnar and an area of poor forest in the Barda Hills.

[2] It should be noted that neither Sterndale nor Prater records chital or four-horned antelope from this part of India.



THE GIR FOREST, JUNAGADH

At the conclusion of my visit to Sasan my impression was that, with the exception of wild pig, game was very scarce in the forest, an opinion I altered after my second visit to the Gir.

Within the forest in Jamwala and Jasadhar divisions wild pig can be found in great numbers, whilst nilgai are abundant. Four-horned antelope, too, are common and chital far from scarce, but sambar seem to be rare. I am told there are plenty of leopards but I saw none, though I heard one and saw pug marks at Sasan. Leopards, however, are very adept at avoiding mankind.

For the rest, we saw several foxes, one or two small parties of langurs, evidence of porcupines, one chinkara (which is only found in the more open easterly parts of the forest) and some mongoose, one of which inhabited the rest-house compound at Jamwala and afforded Sheba many happy hours of innocent amusement. The forest holds no wolves, though these are not scarce in some of the more open and lonely parts of Kathiawar. Two species of wild cat are found, one of a sandy colour (undoubtedly the jungle cat) and one 'with spots', possible the desert cat.

Periodic famines decimate the game. One such disaster took place in 1900 when vast numbers of animals died of thirst and many others in their weakened state were slaughtered by villagers. In 1939 there was another famine which caused a scarcity of game from which the forest only now seems to be recovering. The position has undoubtedly improved, game is on the increase and there are plenty of animals in the forest. The restrictions on fire-arms imposed in 1947 (when the State was taken over) have probably helped in this by limiting poaching by villagers.

I believe K. S. Dharmakumarsinhji of Bhavanagar is producing an article on the birds of the Gir[1], so upon this subject I had best maintain silence, but as regards butterflies, although there was a great abundance of them in October, the number of species was not great (I saw perhaps 43 different kinds) and almost all of them were the commoner varieties. An exception must, however, be made of the skipper, *Coladenia indrani indra,* which I saw on the blossoms of *Acacia leucophlaea,* for this butterfly has never before been recorded as far north as Kathiawar. It was also interesting to see the nymphalid, *Euthalia nais,* so common within the forest as this is the north-western extremity of its range, but not surprising as its foodstuff, an ebony, *Diospyros melanoxylon,* is a common tree in the forest. I also noticed the sword-tail, *Graphium nomius,* a rarity here, and caught a fine series of *Rapala melampus* (the red flash), and one ragged *Spindasis elima* (the scarce shot silverline), both fast-flying strong-blues, on the same blossoms as the skipper mentioned above, probably the foodplant from which *Rapala* had hatched out as I did not see this butterfly at the same flowers elsewhere.

Such then is the Gir Forest, the sole remaining home of the Indian lion.

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My visits to the Gir were, to quote my instructions, 'to study

[1] Published Vol. 48 (December 1948), pp. 187-190.

the present condition of the lions with special reference to their rate of decrease or increase and to consider how continued protection could best be afforded without clashing with human interests.'

Because they are the two classes of persons directly interested in the lions, I relied mainly on forest pagis[1] and maldharis (graziers of the forest villages and nesses) for my information. I also collected data about the numbers of cattle and buffaloes killed by lions.

Owing to bad weather my first investigations were confined to the vicinity of Sasan (including the north of Talala Mahal and the Devalia 'Sanctuary'). In this neighbourhood the unanimous opinion was that the number of lions had decreased quite considerably since the time of the census. The losses of cattle were relatively small.

During my second visit I was able to make a thorough survey of the Jasadhar and Jamwala divisions, covering over 300 miles of forest. Throughout the former, and in the southern parts of the latter, it seems that there has been a slight decrease in the numbers of lions since 1936, whilst in the northern and central parts of the Jamwala division, if the reports of maldharis are to be relied upon, there has been an increase. In both these divisions the percentage of cattle and buffaloes killed by lions during the past year was much greater than around Sasan, and greater in Jamwala than Jasadhar.

In short, the number of lions seems to have decreased considerably since 1936 in the west of the forest, and probably to a small extent over most of the remainder.

In view of my suspicions about the accuracy of the census I am not prepared to commit myself as to the present strength of lions in the Gir.[2]

The casual visitor to the forest probably overestimates their abundance, because lions roam a lot and are much given to roaring at night, so that one lion, or a pair, may make its presence felt over a wide area and so be recorded from several different places.

Nevertheless lions are still common and I feel that there is little cause for anxiety over their future if protection is strictly and intelligently enforced.

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Almost all lion shikar in the Junagadh Gir has taken place from Sasan. All big shooting parties were centered on the Nawab Saheb's fine bungalow there. In addition, the Jetpur block, which is adjacent to Sasan, has at times been the scene of much shooting of lions (at least 5 lions and 2 lionesses having been shot there in 1947)[3]. This is undoubtedly why the decrease in numbers is greater in the west of the forest and, as lions are animals that

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[1] i.e. Forest guards.

[2] If compelled to guess the present number of lions in the Junagadh Gir I should say between 125 and 175.

[3] The slaughter in this year, however, was exceptional.

wander a lot, it may well have acted as a drain on the rest of the area.

Lions have also been shot in the neighbouring Kathi States and a few have been killed within Amreli limits. It is probably no exaggeration to say that as soon as a lion passed over the Junagadh boundary someone was after its skin.[1]

But it is only possible to consider shooting as the entire cause of the decrease if there has been more shooting of lions during the last 12 years than in the previous period. This is doubtful, and, if there has not, there must be some contributory cause, for lions were on the increase until about 1936 (or even later).

Cycles of increase and decrease are well known phenomena in nature[2], but their causes are often obscure, though climate sometimes seems to play an important part, either directly or indirectly. Overpopulation too can upset the balance of nature and cause the pendulum to swing in the opposite direction. The Gir lions may be experiencing the downward trend of such a cycle, which shooting will naturally accentuate. But, of course, a fall in the birth rate (or an increase in the rate of natural deaths) may not of itself be sufficient to cause a decrease in numbers, though in conjunction with shooting it may well do so. As there does not yet seem to have been any very serious decrease I think this is the most likely solution.

It is perhaps necessary to add that I have no evidence that there is any poaching of lions in the Gir Forest.

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Without any doubt the continued survival of lions in the Gir is due to the protection given them during, and just previous to, H.H. the Nawab Saheb's regime. Similarly, were this protection lifted their speedy extinction could be looked for.

The lion is much bolder, more fearless of man and less cunning than the tiger and so is much more easily shot. This explains the disappearance of this noble animal from all its other Indian haunts whilst the tiger manages to maintain its numbers.

I think it may safely be stated that, as the present Administration of Junagadh is enforcing protection even more strictly than before[3], and as the Saurashtra Government has taken steps to prevent the shooting of lions in its territories adjoining the Gir, they are in no danger of extinction, and, indeed, an increase in numbers may well occur. Their only enemy seems to be man, and if left alone by him, I believe them well able to look after themselves.

But this is not enough, for the number of cattle and buffaloes they kill seems to be very considerable.

The following are answers given to my questions, 'How many cattle and buffaloes have been killed by lions in this nes (or village)

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[1] A careful policy of afforestation has of recent years attracted lions to Mitiala in Bhavnagar territory to the east of the forest. Here the shooting of lions has been rigidly controlled.

[2] c.f. The Wood White butterfly in England.

[3] Since the Administration took over no lions have been shot. The last lion shot was killed by Brigadier Gurdial Singh at the time of the occupation.

during the last twelve months? What is the number of your total stock?' While I have no check at all on these figures, nor do I know to what extent they have been influenced by the traditional pessimism of those who take their livelihood from the land, the forest officials who accompanied me believed them to be given in good faith. After a due allowance for the peasant's vagueness about time and numbers, they are probably not a great exaggeration.

Sasan Area

		No. killed		Total stock
Kapuria Nes	...	6		40
Wadvangada Nes	...	2		8
Nes N. of Sasan		1		120
Sandbera Nes	...	2		250
Haripur Village	...	8		400
Total Loss	...		2·3%	

Jamwala Division

Janwadala Nes	...	50		1,000
Kansaria Village	...	8		200
Bhanka Village	...	41		800
Chhodawadi Nes	...	50		500
Babria Village	...	20		200
Banej Nes	...	25		125
Sap Nes	...	3		25
Total Loss	...		6·9%	

Jasadhar Division

Mandwi Nes	...	15		300
Hadal Nes	...	50		1,500
Jeynagar Nes	...	30		600
Chikalkuba Nes	...	25		200
Sarakadia Nes	...	25		500
Anon Nes	...	20		300
Total Loss	...		4·85%	

In fact, as kills of forest game made by lions are seldom found, it is to be suspected that, over a great part of the forest, they rely on cattle and buffaloes for most of their food.

It is fully realised that this is a very serious allegation to make, for it is bound to raise the question of whether it is in the human interest to preserve the lions at all. However, before the very drastic step of removing preservation should even be considered, it is very necessary to collect much more detailed reports than the comparatively meagre information I obtained from some 18 villages and nesses.

It is of the first importance, then, that accurate accounts should be kept of the numbers of cattle and buffaloes killed by lions.

On the other hand, in defence of the lions as it were, it must be borne in mind that a large proportion of the losses are due to the carelessness of the owners in bringing their cattle home late, in letting single animals wander, and in accidentally leaving them out at night. Also the fact that they receive the benefit of grazing that is free, or for which only a very small fee is charged, on some of the best grazing lands in India, may be considered to some extent as compensation for any loss they may incur.

Any monetary compensation for losses within the forest would, for obvious reasons, defeat its own ends. The increase in the number of old and sick cattle killed by lions would probably be startling! Outside the Gir, which for this purpose should be held to include all areas generally inhabited by lions, compensation might well be considered.

That India possesses the last home of the lion in Asia should be a matter of national pride, and it is hardly for me to assess the price she should be prepared to pay for its survival; but removal of protection and its consequent extinction would certainly create an unfavourable impression abroad.

The aim of the protective policy must be to strike a happy mean which will maintain the stock of lions at a safe level and at the same time endeavour to reduce the losses of cattle.

It is therefore essential to ascertain as accurately as possible by a census the number of lions in the forest.

This in the first instance should be held in April of next year (1950) and subsequently at two yearly intervals.

These censuses and the details of cattle losses will be the essential data upon which to work. From them will be decided whether the shooting of lions is to be prohibited, or the quota to be shot, as well as the areas in which shooting is to take place.

In addition, because it will provide further valuable information, every effort should be made to ensure the reporting of lions that are found dead, together with details of sex, approximate age and, if possible, the cause of death. A record of these should be kept together with that of those which have been shot.

It is probably optimistic to hope to break the maldhari of centuries of habit by persuading him to bring his cattle home earlier and to keep a more careful watch over them, but every endeavour should be made to do so. He is fatalistic over his losses and takes them very much as a matter of course.

At the same time the lions' natural food should not be neglected, for if they are to be discouraged from feeding on cattle there must be an abundance of game for them to fall back upon. It is possible that an increase in the quantity of game in the forest will of itself reduce the losses of cattle by offering increased opportunities there of easy kills . . . as the lions undoubtedly prey on cattle as they are easily come by.

With this in view the forest should be made a sanctuary for all other kinds of game (except leopards) and permission to shoot them should under no circumstances be granted. Leopards, however, should be treated as vermin as they prey on many of the

animals upon which the lions feed (or should feed) and consequently are an unnecessary drain on their food supply.

For the rest, perhaps the prevention of jungle fires is the surest way of preserving the natural life of the forest.

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If, because of an increase in the numbers of lions or as a measure to reduce their depredations on cattle, it is essential to take the drastic step of reducing their numbers, this should only be done after very careful consideration and carried out very carefully over a period of years.

If it is considered necessary to shoot lions, permission to shoot should only be granted to responsible persons who are reputed shots on the explicit understanding that they will personally follow up wounded animals. Although no cases of man-eating have as yet been recorded there is no reason why a wounded beast should not adopt this habit. Though lionesses would not ordinarily be shot, there have been instances where a tigress has passed on this habit to her cubs. A lioness might well do the same.

II

Sasan (October)

Accompanied as usual by Sheba, I arrived in Junagadh on September 30th and made all arrangements for a very thorough tour of the Gir Forest by car. Unfortunately the night before I was due to set out it began to rain and a report came through the following morning that already the roads were in bad condition. So our departure was postponed in the hope of an improvement in the weather. After raining steadily all day until evening, the storm greatly increased in intensity, and some of the heaviest rain I can ever remember fell throughout the whole night, accompanied by persistent lightning and violent thunder. As road travel was now out of the question I decided to go to Sasan by train and there make my headquarters with the object of covering as much of that neighbourhood as I could on foot and by pony. If it could be arranged I should pay the forest a second visit in December to complete my investigations.

As it turned out the weather did me a good turn for the roads had not been repaired after the monsoon and were already impassable before this storm.

Although this limited the scope of my activities, it greatly added to my comfort, for the Sasan bungalow is the Nawab Saheb's old shooting lodge, a large and most comfortably furnished house. As the State had kept on all the old mehmandari arrangements I spent a week in luxury.

The bungalow is situated amidst pleasing surroundings in a grassy park with jungle and hills surrounding it on three sides. Though perhaps it does not possess quite the same remote charm as Jamwala, my headquarters when I returned in December, it is a delightful enough place. The bungalow itself is remarkable for the two giant beds which were installed for the visit of a certain very large Viceroy and Vicereine, and for the phenomenal

number of lizards that have their habitation there . . . much to Sheba's joy, for lizard shikar ranks high in her list of blood sports.

My routine here was very peaceful. At daybreak I was woken by the persistent call of a brain-fever bird somewhere in the depths of the jungle, and soon after sunrise I would walk or ride to a neighbouring village or nes where I questioned the inhabitants and so, bit by bit, amassed a fair amount of useful information. After lunch I dozed and in the evening the morning's programme was repeated. When I returned I would sit peacefully in front of the bungalow sipping cherry whisky (which, together with Eritrean beer, were the extremely improbable, but nevertheless most acceptable, drinks supplied to me by the State !) listening to the evening chatter of the mynahs and paroquets or watching the play of light on the wonderful bank of clouds that built itself up to the north on three successive evenings. When the pink of the clouds had changed to a toneless grey I would move inside and write up my notes for the day.

Although in my wanderings I went as far afield as the Devalia Sanctuary (a misnomer as the area is in reality a reserve for lion shikar) and saw much of the forest, I came across no game except wild pig, and saw no lions. There is, however, plenty of evidence that there are lions about at other seasons of the year (though in no great numbers) but it appears that most of them leave this part of the forest for its outskirts during the monsoon and just after it.

This visit to Sasan was valuable as a preliminary survey but insufficient to give me an impression of the whole forest.

Fortunately I had no difficulty in fixing up a second visit in December.

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Jamwala (December-January)

Accompanied on this occasion by my wife as well as Sheba, we arrived in Junagadh on Christmas Eve and spent that afternoon arranging details of our trip, devoting the following day to sightseeing. Junagadh is a most attractive town and its pleasant surroundings are a remarkable contrast to the rest of Kathiawar.

Early on the 26th we set off to motor the 60 miles to Jamwala. Our journey was without incident except at one point where the road was blocked by a fallen tree and we had to make a detour through the forest, an operation that entailed the felling of several large saplings. At Sasan we picked up Mr. Sheikh, the A.F.O. at Jamwala, who was to look after us, and arrived at Jamwala in time for a late lunch.

Jamwala is on the southern edge of the Gir on the banks of the Singavada river, the rest-house being situated to the north of the village on a small hillock that gives a view over fields to the forest. To the left lies the river, a pleasant stream of no great size that runs between banks thickly clothed with karanj[1] and jambudo[2], the latter a graceful, water-loving tree that resembles

[1] *Pongamia glabra.* [2] *Eugenia jambolana.*

the willow. Beyond the river are the white buildings of the divisional headquarters and behind them small jungle-covered hills. It is a tranquil place, and remarkable for its greenness even at that time of year when most of Kathiawar, because of the failure of the rains, was already half desert.

The same evening we began our investigations by driving out to Alsalia Nes, 8 miles into the forest, learning at the same time what the forest roads were really like, for although the road by which we had come from Junagadh was tolerable, the remainder are bad beyond description. It was only the remarkable skill of our driver that saved us from disaster on many an occasion.

Owing to the suspicious character of the rabari headman of Alsalia our investigations were fruitless. He was convinced that we wished to seize one of his buffaloes and tie it up as bait for a lion. Such things, he said, had happened in the past. He had no idea how many buffaloes he possessed, no lion had ever killed any of them, and furthermore he had not seen any lions for a very, very long time!

He was a fat, bouncing little man with a remarkable red, white and black plaster attached to his stomach. It was, he told us, made of red chillies and the sticky white sap of umbro[1], and was an infallible cure for tummy-ache. The third ingredient, one assumed, was grime collected during manufacture. As Mr. Sheikh aptly remarked, it was an undoubted example of jungly antiphlogistine. However, our rabari acquaintance's suspicions did not cause him to neglect the courtesies of the forest and he made the customary offer of milk. Indeed he seemed very hurt when we refused it on the plea that it was growing very late.

Whenever one halts at a forest village or nes this offer of tea or milk (and sometimes food) is made, and, because they are a genuinely hospitable people, refusal is taken as discourtesy. As one is expected to stop at every habitation this makes progress a little difficult.

Both tea and milk are served in a cup, but it is etiquette to pour them into the saucer and drink from that. Tea is sometimes infused with ginger or cinnamon, both of which strange mixtures are quite pleasant on a cold morning.

My wife heard lions roaring throughout the night: I was far too soundly asleep to hear anything.

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Having failed at Sasan, it was essential to see at least one lion at Jamwala, if only as direct evidence that the Gir lions were not an elaborate myth! On this occasion Mr. Sheikh was successful beyond all expectations and showed us four within 72 hours of our arrival.

On the evening of the second day we bumped our way eastwards in search of news along the track that runs to Jasadhar. Four lions had been heard near Thordi, six miles away, and two had been seen at Bhanka, a couple of miles nearer home. As these

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[1] *Ficus glomerata*, a species of fig tree.

two lions had walked into Bhanka village the previous night we decided that this was the best place to tie up a young buffalo.

At 4.45 a.m. we were woken by Mr. Sheikh with the news that a pair of lions had killed shortly after two o'clock. Hastily driving to Bhanka, we halted on the near side of the village and made our way as silently as possible through its tortuous ways to come out on the far side behind a broken wall. From here, at about 80 yards distance, we caught two dusty shapes in the light of our torches before they slunk off into cover. As our view of these lions had been indistinct we decided to bring the car round in the hope of picking them up in the headlights. So we beat a retreat by the way we had come and returned with the car. Then fortune favoured us, for we immediately discovered the lions close to our left, and instead of making off in that direction they came out into the road directly in front of the car. The next fifteen seconds were fraught with excitement, for although the lion almost immediately bounded off to the right and disappeared, the lioness shambled straight down the road with us wildly accelerating behind her in mad pursuit. So close were we at one time that I thought we should run her down. Then she too, tiring of this irritating game, bounded off into the bushes after her mate. The driver showed every sign of making the car do the same and it was only with the greatest difficulty that I restrained him and persuaded him to turn back and make for the village.

Leaving instructions with the villagers to follow up the lions as soon as day broke to find out where they were lying up, we drove to the range headquarters at Dhabala to tell the forest pagis to do the same.

Here we were glad enough to drink tea and warm ourselves at a large wood fire. As soon as dawn began to make its appearance we set off for home.

Owing to the villagers' late start (much time was spent in gossiping and drinking tea) the tracks were lost and so was our chance of seeing the lions by day.

The following night a cow was killed at Jamwala, and fresh pug marks found by an ex-pagi named Kaloo Mahommed, and followed until he discovered a pair of lions lying up on a hilltop between Bhanka and Jamwala. As they were out in the open, just over the brow of the hill, it was planned that we should approach from the far side, walk up as near as possible and hope for a close photograph of them. This sounded alarming, especially as the suggestion came from the Settlement Officer, Mr. Nur Mahommed Balooch, a charming fellow, but one who had already struck us as being of a singularly reckless nature! I also remembered the story of a rabari, who, to demonstrate the harmless nature of lions, rushed up to one brandishing a stick and shouting . . . and was promptly killed.

So once more we returned to Bhanka, and, after walking perhaps two miles to the low, scrub-covered hill upon the top of which the lions had been seen, we were met with the news that they had moved into a nala close by and were now sleeping in thick shade that would make photography difficult. Therefore

plans had to be changed and it was decided (much to the Settlement Officer's disappointment) to place a machan at the top end of the nala, tie up a goat close by, and gently drive the lions up the nala in the hope of a photograph of them killing the goat.

While the goat was being brought from the village we relaxed in the cool shade of a babool tree. It was very peaceful and Mr. Sheik and the Settlement Officer told us comforting stories to show the magnanimity and harmless nature of lions.

At last the goat arrived, but, when all was ready, it was found that the Settlement Officer had obstinately reverted to his original plan and insisted that we first try to photograph the animals on foot, and then, if they had not been too much disturbed, take up our position in the machan. Accordingly we set off in the following order. First came two pagis as vanguard, one to the right and one to the left, each armed with an ancient muzzle-loader charged with a large but far from spherical ball. Between the pagis, but a little to the rear, came myself, somewhat apprehensive and with camera ready for use, followed closely by the Settlement Officer, another armed pagi, and my wife, whom I knew, by the look on her face, to be remembering Rajkot Cemetery where are already interred two English officers killed by lions (as well as two College Principals' wives who had met a less violent death). Behind her came Mr. Sheikh, then the village patel, and finally two more armed pagis. If it is added that most of the pagis were of Baluchi descent and wore beards of formidable aspect it will be appreciated that our little company presented an unusual spectacle.

Proceeding thus, we crossed the open hill-side and made a stealthy, but far from silent, descent into the nala, picking up on the way the ex-pagi, Kaloo, who had been keeping a watch on the lions from the top of a tree. The lions had moved once more and were now out of sight. So we advanced carefully up the nala for perhaps one hundred yards, seeing nothing, until, at perhaps twenty paces directly in front, the lion rose from where he had been lying in the shade of a small tree. For the next fifteen seconds I was too fully occupied in trying to take the photograph to register accurately either the exact appearance of the lion or what was going on around me. But as far as I can recollect, just as I raised my camera, I was very firmly grasped and propelled forward by the Settlement Officer who apparently thought that honour would only be satisfied with a close up of the beast's head, while a few yards behind me my wife received the same cavalier treatment from Mr. Sheikh. When I had steadied myself and released the shutter of the camera, the lion had already given us a look of pained surprise and begun to make off at a leisurely pace into the vegetation on the other side of the tree. At the same time the lioness, who had been lying up till now concealed in the grass close to the lion, rose up and trotted off to the right. This was a signal for the outbreak of the strangest cries from our company, some bleating like sheep, and others making the most curious popping noises with fingers and mouths. I then found myself running rapidly after the lioness in the company of the Settlement Officer and the two pagis, with the result that I got a very close

photograph of her just *after* (as it turned out) she had disappeared into a thicket.

Although I had often contemplated the unpleasant circumstance of being pursued by some large beast of prey, never in my wildest dreams had I expected to be involved in the reverse of this situation.

When the lioness came into sight once more, we watched her make her way up the hillside facing us, stopping every now and then to look for her mate. When she had disappeared over the brow of the hill, we remembered the lion and made a wild rush, to the accompaniment of the aforesaid strange noises, to a point of vantage from which we could overlook the head of the nala. As we did so he broke cover and ambled across the open hill-side, perhaps sixty yards away, the very embodiment of dignity and grace. He was a magnificent beast with a dusky mane, and I was struck, as I had been struck when I first saw a tiger in the jungle, by his apparently immense size and the sense of his tremendous power.

The whole party was highly delighted at the success of these manoeuvres. It was, they declared (and I can well believe it), the first time that a lion had been photographed by this method, but, the jemadar-pagi added wistfully, if only we had been quiet we should have got *much* closer.

It is sad to have to admit that the photograph was hardly a success, for at the moment of taking it the lion had already concealed himself so effectively among the leaves of the bushes that, though his head is visible, it requires some considerable exercise of the imagination to make it out.

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Having both seen and photographed lions, we were now free to explore the forest. Accordingly, early the next morning, we set out for Jasadhar. This was in the nature of a pioneer expedition for it is doubtful if any sane person has ever attempted to take a car so far over such bad roads. However, we accomplished it with little damage to ourselves apart from a few bruises, and to the car apart from a bent steering rod.

We followed the road that leads northwards into the middle of the forest and there turned east, stopping for a short spell at Banej Nes to examine the old antimony diggings and to drink tea flavoured with ginger.

Ten miles further on, after crossing a small range of hills over which the road was more appalling than usual, we dropped down to Tulsi Shyam where Krishna's ancient temple stands in an attractive jungle setting.

As a place of pilgrimage it is of some considerable importance, as may be seen from the size of the dharamsala attached to it, for it caters both for spiritual comfort and bodily relief, being placed at the site of a hot spring. Its waters are led into a commodious tank for the use of the pilgrims and the fact that they are hot enough to make the act of bathing a penance is quite in keeping with the spiritual nature of the place.

The priest, a most hospitable soul, received us very warmly and having shown us round the temple, entertained us to an excellent lunch. Then having presented Sheba with a luddu the size of an orange (which she devoured at a gulp and so gained great local izzat) he set us on our way with many requests that we return for a long stay.

Beyond Tulsi Shyam the jungle turned to thick Acacia scrub, and, being less cut up by rocky nalas, progress was more rapid. Even so we did not arrive at Jasadhar until well after 1.00 p.m., the whole journey having taken us some five hours. As Mr. Sheikh had promised, we found Jasadhar a 'quiet' place; indeed few places can be more remote and isolated. So difficult is it to approach that one does not imagine that the A.F.O. stationed there is much troubled by interference from his superiors, an advantage which a recent A.F.O. apparently appreciated, as the story of the haunted bungalow goes to show.

This bungalow is the A.F.O's quarters, and we had been told about it in Junagadh though nobody was able to give us details of the haunting. Consequently it was disappointing to find out, on arrival at Jasadhar, that the ghost was a 'propaganda' ghost. . . that is, merely a rumour spread by the previous A.F.O. to prevent anyone displacing him.

Panthers abound round here and Sheba had to have an armed guard when I took her for a stroll in the jungle.

Our return, which was along the southern edge of the forest, was not quite so uncomfortable, as stretches of the road had been repaired. It was dark long before our return to Jamwala.

The following day was devoted to a well-earned rest.

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The six days that were left to us were spent pleasantly in making long or short expeditions into the forest and the country round about. Of long trips there were two, of which the most ambitious took us to Dhari, the military headquarters of Amreli, for the purpose of carrying out very necessary repairs to the damaged steering rod. Our way led across the forest to Sap Nes and through the narrow strip of the Baroda Gir. This tract is good thick forest which undoubtedly contains lions (there were, so we were told, plenty round Sap Nes, and this was within the central forest area where they seem to have increased their numbers of recent years), but whether any would be recorded from here during a census is doubtful as this northern side of the hills is dry and would probably hold few drinking places in April.

At Dhari, which is a neat little cantonment set in the middle of a desert wilderness, we inflicted ourselves unheralded on Mr. Sheikh's uncle, the colonel commanding the station. He rose nobly to the occasion and gave us lunch and tea.

Our second long expedition took us to Kankai, an unimpressive little temple which is nonetheless the religious centre of the Gir. Our way as usual led through Chhodawadi Nes, which may well be termed the Charing Cross of the forest, and thence westwards through abrupt little hills covered with thicker jungle than we

had seen before. Much of the grass was very long as we were passing through a reserved area where no grazing was allowed, and many of the trees showed signs of bad damage from fire, the scourge of this forest. There was plenty of game about and we saw large numbers of pig and nilgai, all very tame for there is little to disturb them.

At Kankai we found the priest away, but his chela, a venerable old gentleman with a flowing beard, took charge of us and, having shown us the temple of the goddess Kankai, led us down to the river to point out to us a green tree snake (*Dryophis mycterizans*) that was wound in and out among the branches of a leafless bush on the other side. It was a wonderful example of natural protection for it was so like a long ribbon of weed that I was not convinced it was a snake until it was caused unwillingly to move by a stone that landed close by.

When we halted at Chhodawadi on our return, Sheba, who had already performed prodigious gastronomic feats at this nes, finally gained undying fame by drinking five pounds of buffalo milk: she also met her Waterloo, for she could no more.

Two other trips, neither of which could really be considered to be in connection with lion preservation as they were into Amreli territory, well south of Jamwala and the forest, were to Mul-Dwarka and Jagatia.

Mul-Dwarka is a very ancient temple intimately connected with the Lord Krishna's sojourn in these parts. What is left of it, which is little enough as the building is in a state of almost complete decay, is situated on a small promontary, jutting out into the Arabian Sea close to the quaint old walled town of Kodinad. There is a small fishing village nearby whose main catch is a species of small hammer-headed shark.

When we left Mul-Dwarka just before dusk, the harsh but melodious *Kronk*! *Kronk*! of kūnj (demoiselle crane) was to be heard as a flight of these birds came into the fields nearby.

One of my pleasantest recollections of Kathiawar will always be of the wonderful formations of these birds that wing their way overhead at daybreak and shortly before dusk to the sound of this peculiarly attractive note. Their mastery of the art of formation flying far exceeds that of any other bird I have seen and it is always a joy for me to watch them. The variety of their formations is endless, but they always fly in echelon with each bird avoiding the slip-stream of the bird in front, and rapidly change from one formation to another with practised skill. Sometimes, especially with flights that take place during the daytime, these formations break up and the birds circle round and round with much tumult in an untidy irregular mass, presently to resume formation, fly on for a stretch, and then repeat the performance.

Jagatia, not far from Jamwala, is remarkable for natural gas! In a field close to the small village six large iron pipes emerge from the ground, tapping the reservoir of gas some two hundred feet below the surface. As the pipes have been in position for several years some millions of cubic feet of valuable gas must have been uselessly dissipated into the surrounding atmosphere, for the

supply has been put to no use at all, except by the occasional villager for cooking his dinner.

The gas smells of sulphur, is easily ignited and burns with a clear smokeless flame.

On the 6th of January we reluctantly returned to Junagadh, and the following day made our dusty way to Rajkot.

* * * * *

When other memories of our visit to the Gir fade, one which will always remain is that of the hospitality we received from Mr. Sheikh, who told us that he considered us his honoured guests, from his uncle, from the priest at Tulsi Shyam, from everyone down to the humble maldharis of the forest.

This part of Kathiawar has retained much of the old courtesy that so many parts of India have lost long since.

NOTES ON BIRDS OF THE IRRIGATED AREA OF SHWEBO DISTRICT, BURMA

BY

W. L. ROSEVEARE, I.S.E. (Retd.)

(With a sketch map)

INTRODUCTION

Except where otherwise stated, these notes cover observations made between October 1930 and March 1934 in that portion of the Shwebo district irrigated by the government canal systems. The trivial names used are those adopted in *Birds of Burma* by Smythies.

GLOSSARY OF BURMESE WORDS USED

Chaung—A stream-bed that goes dry, or practically so, for part of the year.
In—A shallow natural lake.
Indaing—Dry forest without bamboos.
Kaing—Land in a river bed, exposed and often cultivated in the dry weather.
Kazin—The low bank surrounding a rice-field.
Kokkobin—*Albizzia lebbek*. A large common roadside tree.
Mayin—A rice crop grown during the dry weather, and therefore practically restricted to the borders of *ins*.
Nyaungbin—The pipal tree.
Tanaungbin—A tree of moderate size.
Taze—A large area, adjacent to the Irrawaddy, in the Minbu district, which is covered only by very high floods.
Ya—Dry (i.e. unirrigated) cultivation, other than *kaing* (q.v.).

ABBREVIATION

I.B.—Inspection bungalow.

LIST OF SPECIES

Corvus macrorhynchos. The Jungle Crow.

Habits.—Frequently seen in company with House Crows; generally solitary in pairs, but occasionally in flocks.
Status.—Fairly common; observed in every month.

Corvus splendens. The House Crow.

Habits and Food.—A pair once observed wading in shallow water and picking food off the surface. Sometimes seen feeding on young buds of *nyaungbin*.
Nest and Eggs.—One nest observed under construction as late as 10 June, but was never finished. Nests seen occasionally in same tree as those of Pond Herons and Little Egrets.
Status.—Very common every month.

Urocissa erythrorhyncha. The Red-billed Blue Magpie.

Status.—Occasional cold weather visitor to the area. Earliest date 29 October.

Dendrocitta vagabunda. The Tree Pie.

Habits and Food.—Usually seen singly, occasionally in pairs; frequently in cotton trees, mangoes and tamarinds.
Status.—Uncommon, especially in hot weather and rains. Not seen between March and 4 August.

Crypsirhina cucullata. The Hooded Racquet-tailed Magpie.

Voice.—Twice seen uttering harsh raucous call.

Habits.—Generally seen singly, but family parties observed between July and October.

Status.—Seen in all months except May and June. Latest date 29 April, earliest 18 July. Never common.

Argya gularis. The White-throated Babbler.

Voice.—I once saw it uttering a *cheep cheep* call, followed by a trill.

Nest and Eggs.—Fledgling handled as late as 16 September.

Status.—Common in every month.

Timalia pileata. The Red-capped Babbler.

Identification.—Deep red crown and pure white forehead are conspicuous in the field; otherwise very similar, both in appearance and movements, to the Yellow-eyed Babbler.

Habits and Food.—Bird seen on 29 April was among bushes at least a mile from any moisture.

Nest and Eggs.—The same bird was behaving as though near its nest, but I failed to find it.

Status.—Very uncommon, only two observations, 29 April and 22 August.

Chrysomma sinensis. The Yellow-eyed Babbler.

Voice.—A harsh chattering call, rather like a Burmese Shrike's or Blanford's Bulbul's, but much softer. Occasionally utters a beautiful song, something like a Magpie-Robin's, from top of tree or bush. Bird seen singing as late as 16 October.

Habits and Food.—Generally seen in dry scrub jungle, but also in wet rice-fields and swamps. On one occasion, 16 December, at least 6 birds emerged from cracks in dry mud at the edge of Wetlet Lake when I had almost trodden on them.

Nest and Eggs.—Bold when nesting. One bird brought material to nest when I was within 6 yards and plainly visible. The beautiful cobweb framework had been completed and a start was being made in adding grass blades to it. Nest building observed on 13 September (latest date), and in another case young just able to fly observed on 30 September.

Status.—Fairly common in hot weather and rains, less so in cold weather.

Ægithina tiphia. The Common Iora.

Voice.—One phrase may be represented by the words *Oh, here we are.* The plaintive call *we-e-e-tu*, stated by Stuart-Baker[1] to be uttered only in the rains, was heard as early as 12 February and as late as 7 November. The *we-e-e* is sometimes repeated many times without the final lower note. A male was once seen singing cheerfully on 2 August, although moulting and very bedraggled. On the same day of the year, in Mandalay district, I once saw a female uttering a loud trisyllabic note while sitting on her nest.

Nest and Eggs.—Male with all-black crown of breeding plumage once observed on 13 February. Partial breeding plumage seen on 20 September (latest date).

Status.—Observed in all months, but not so commonly during the rains.

Habits.—Occasionally seen catching insects on the wing.

Chloropsis aurifrons The Gold-fronted Chloropsis.

Habits and Food.—Whenever observed, it was feeding in trees in bungalow compounds.

Status.—Very uncommon, and only seen between 23 September and 26 January.

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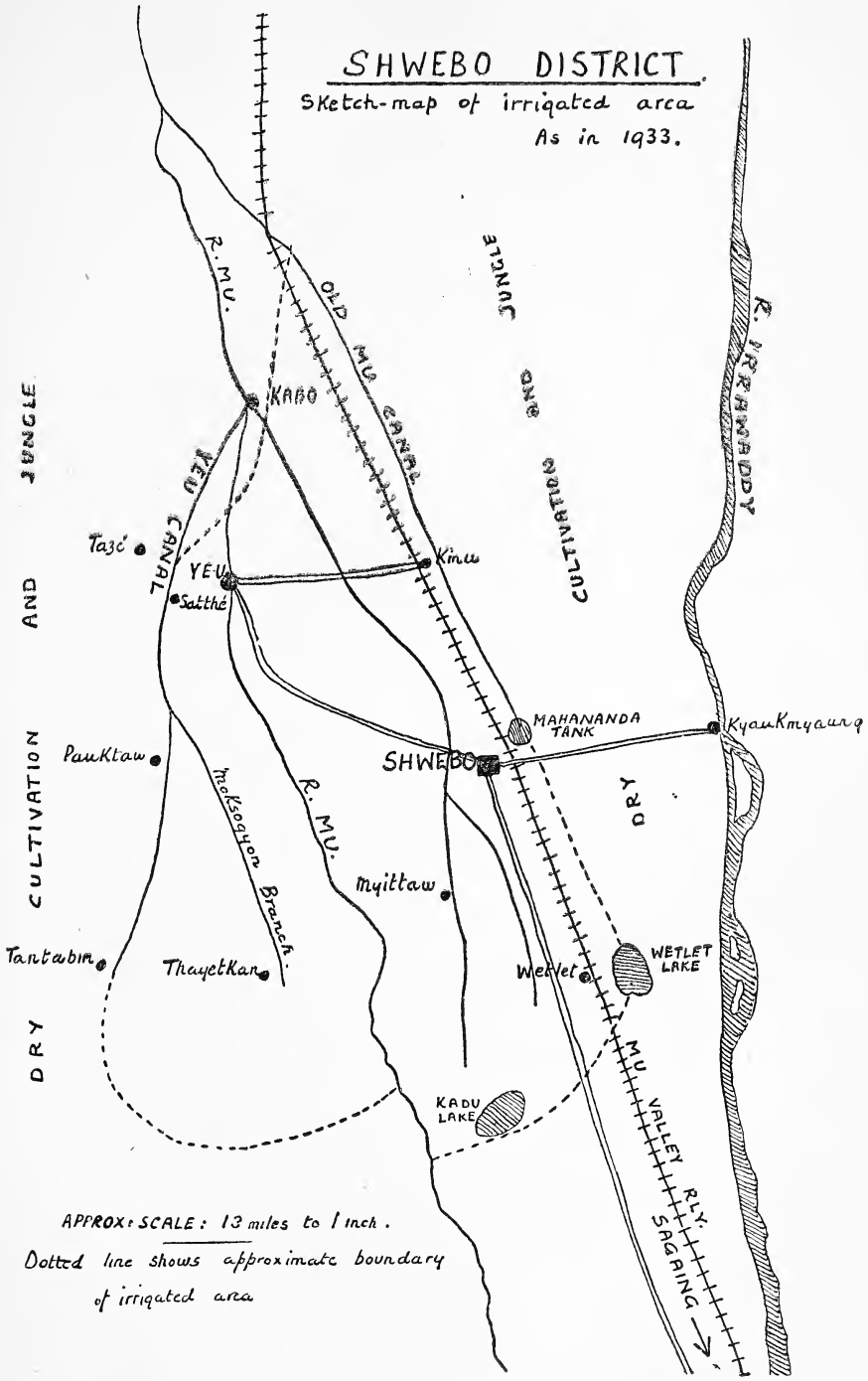
[1] *Fauna of British India* (Birds).


SHWEBO DISTRICT.
Sketch-map of irrigated area
As in 1933.
R. IRRAWADDY
JUNGLE AND CULTIVATION
DRY CULTIVATION
JUNGLE AND DRY CULTIVATION
R. MU.
OLD MU CANAL
YEU CANAL
KABO
Taze
YEU
Satthé
Kinu
SHWEBO
MAHANANDA TANK
KyauKmyaung
PauKtaw
Meksogyon Branch
R. MU.
Myittaw
Tantabin
ThayetKan
Wetlet
WETLET LAKE
KADU LAKE
MU VALLEY RLY.
SAGAING
APPROX. SCALE: 13 miles to 1 inch.
Dotted line shows approximate boundary of irrigated area

Molpastes cafer. The Red-vented Bulbul.

Status.—Fairly common, observed in every month.

Pycnonotus blanfordi. Blanford's Olive Bulbul.

Voice.—Usually an ugly grating call, but I have seen it uttering quite a musical trill.

Nest and Eggs.—Nest very loosely woven. Sometimes found entirely suspended, sometimes supported from below as well. Found in creeper on house porch, in small cutch tree, in thorn bush and in pile of dead brushwood. Fledgling seen 4 April (earliest), eggs found 21 June (latest).

Status.—Very common in every month.

Saxicola caprata. The Stone-chat.

Voice.—A male was once seen uttering a pretty song of 6 syllables, followed by the ordinary *tsak-tsak* call.

Habits and Food.—Frequently seen perched on rushes in Mahananda tank and Wetlet Lake, and on one occasion in September a number were seen on growing paddy. Once observed on top of toddy palm and once on roof of bungalow.

Status.—Observed in all months except March, but scarce in April and not common in May.

Saxicola torquata. The Japanese Bush-chat.

Habits and Food.—Seen more than once perched on bushes etc. growing in water.

Status.—Observed between 22 August and 16 May, but never common.

Luscinia svecica. The Red-spotted Bluethroat.

Identification.—White eyebrows and chestnut patch on throat were usually conspicuous.

Habits and Food.—Seen on paddy field *kazin,* in scrub jungle, and on abandoned canal bank. One stood very erect, but ran with body bent forward and tail uplifted.

Status.—Very uncommon; only observed three times.

Calliope calliope. The Common Rubythroat.

Habits and Food.—Once seen feeding like a wagtail, running very fast in short rushes, with head lowered, usually ending by catching an insect.

Status.—Very uncommon; only observed three times; latest date 16 April.

Copsychus saularis. The Indian Magpie-Robin.

Voice.—In the cold weather I frequently heard it utter a long loud rather plaintive whistle. The earliest date I heard its song was 27 February.

Nest and Eggs.—Fledgling, just able to fly, observed on 7 August.

Status.—Observed in every month, but very seldom in October.

Monticola solitaria. The Blue Rock-Thrush.

Voice.—On two occasions I saw it uttering a harsh grating cry, something like a roller's, whilst vigorously bobbing its head low and its tail high.

Habits and Food.—It was fond of the Shwebo golf-course and the Kabo headworks. Its food includes caterpillars.

Status.—Fairly common in the cold weather. Earliest observation 30 September, latest 3 April.

Siphia parva. The Red-breasted Flycatcher.

Identification.—Red on breast only once observed, and then only a very pale rufous tinge, visible only intermittently.

Voice.—The loud harsh chirp has reminded me of a cricket, and also of a Streaked Fantail Warbler's note, though more continuous.

Habits and Food.—I once saw a number hawking flies from perches on clods of earth at the edge of a tank.

Status and Distribution.—Fairly common in cold weather. Earliest date 15 September, latest 14 February.

Eumyias thalassina. The Verditer Flycatcher.

Voice.—The only specimen observed in the area (on 13 January 1934) was uttering a chat-like call, whilst perched in a mango tree.

Status.—Only once observed in the area, on 13 January 1934, at the head of Distributory No. 1 of the Moksogyon Branch Canal.

Culicicapa ceylonensis. The Grey-headed Flycatcher.

Habits.—On two occasions, both in November, I observed one hawking insects from the top of a tall pipal tree in Pauktaw inspection bungalow compound, on the bank of the Yeu canal. On a third occasion, in February, I saw one fly down from a mangoe tree to the surface of a canal and back like a flash. The continual fanning of the tail is a conspicuous habit.

Status.—The above observations were the only ones in the area.

Tchitrea paradisi. The Paradise Flycatcher.

Status.—Observed twice only in the area, on 8 April and 22 July. A third observation was made at Kyaukmyaung on the Irrawaddy, a short way outside the area, where on 23 April two full-plumaged adult males and one female were seen together.

Hypothymis azurea. The Indian Black-naped Flycatcher.

Habits.—On two of the three occasions on which I saw this bird in the area it was hawking insects from a perch in a mango tree. On the third occasion it was perched in a bush close to a Magpie-Robin which was in full song.

Status.—Observed once in November and twice in February. On two occasions it was in an inspection bungalow compound, and on the third one in the Civil Lines at Shwebo.

Chelidorhynx hypoxanthum. The Yellow-bellied Flycatcher.

Status.—Observed once only, on 19 January at Kabo (under 500 ft.).

Rhipidura aureola. The Burmese White-browed Fantail Flycatcher.

Habits.—Two birds competing for an insect once flew within a yard of my face when I was standing in the open in white clothes, after which one of them perched on a hedge one foot above ground within three yards of me. On another occasion I saw a bird perched at the edge of the Mahananda tank.

Status.—Uncommon September to February; not observed in other months.

Rhipidura albicollis. The White-throated Fantail Flycatcher.

Habits.—Once seen hunting for food in the bottom of thick bushes. Twice seen bathing in a stream.

Status.—Seen throughout the year, including August. Usually uncommon, but on 23 April 1933 birds were very numerous at Kyaukmyaung on the Irrawaddy.

Lanius colluroides. The Burmese Shrike.

Identification.—Reddish tinge on lower plumage only once observed. The same bird also had the lores almost white.

Voice.—Once in June I saw a bird uttering an unusual whining call.

Habits.—I once observed a bird rubbing insects long and hard on a twig before swallowing them.

Status.—Common most of the year, but in March they began to disappear and I never saw a bird in May. In June they became exceedingly common and remained so during July, after which their numbers fell again to normal

until the following March. On their re-appearance in June the adults were generally very noisy and excited, flapping their wings and flirting their tails, I never saw any other sign of mating or nesting, but have seen young birds from June to August, the earliest date being 16 June.

Lanius nasutus. The Black-headed Shrike.

Status.—Only seen once in the area, on 21 January at Wetlet. Clearly distinguishable from Burmese Shrike by larger size and much lighter upper plumage.

Lanius cristatus. The Brown Shrike.

Status.—Uncommon. Only observed three times, October to January. Earliest 9 October.

Tephrodornis pondiceriana. The Common Wood Shrike.

Habits.—Once observed hawking flying insects from a perch in a tamarind tree.

Status.—Uncommon even in the cold weather, and not observed between 23 April and 21 October.

Pericrocotus peregrinus. The Small Minivet.

Status.—Only observed once, in jungle near the Shwebo-Kyaukmyaung road. A flock of 8 or 10 birds was flitting restlessly and erratically like bees about the highest trees.

Pericrocotus erythropygius. Jerdon's Minivet.

Habits.—Never observed in high trees, but usually perched on bushes or long grass, or even on the ground.

Nesting.—Birds seen at nest 4 ft. up in a small cutch tree on 22 July. Nest was a shallow cup made of fine grass very compactly cemented with saliva, ornamented with bark and remarkably well camouflaged. Three eggs with very good protective colouring. On 23 August I saw another nest in a similar position and similarly constructed and camouflaged. The sole occupant was a young cuckoo, being fed with caterpillars.

Status.—Seen once in February and once in March; otherwise only between June and October, and uncommon even then.

Lalage melaschista. The Grey Cuckoo-Shrike.

Status.—Observed on 20 August in jungle near the Shwebo-Kyaukmyaung Road, and once in November in the compound of Taze inspection bungalow.

Graucalus javensis. The Large Cuckoo-Shrike.

Habits.—Flight slow and direct. The seven observations made in the area were all in bungalow compounds.

Status.—Uncommon, and only seen between 7 October and 15 February.

Artamus fuscus. The Ashy Swallow-Shrike.

Voice.—In October I have heard birds on the wing uttering a plaintive call.

Habits.—Nearly always seen on or around toddy palms or telephone wires. One of a nesting pair was once seen fearlessly driving away a crow.

Nesting.—The pair just mentioned were nesting at the top of a toddy palm on 22 March. Grass bents were being used in construction.

Status.—Never observed between 22 March and 14 June, otherwise in every month, but never common.

Dicrurus macrocercus. The Black Drongo.

Identification.—A noticeable glossy blue sheen occasionally observed on plumage.

Voice.—The usual rather raucous call was sometimes punctuated at frequent intervals by a beautiful clear whistle—an amazing contrast. Another

call was much like the harsh chatter of a shrike, and others might well be mistaken for an iora's. Possibly this is mimicry.

Habits.—Several birds once observed in company with a nightjar at dusk, hawking insects a few inches above the ground from a standing position on the surface of a road. On another occasion I saw more than 12 birds, in company with some Jerdon's Mynahs, swooping down from perches to pick food from the surface of a small pool.

Nesting.—Nest never observed in the area, and fledglings only once. In the Mandalay district, however, I once saw a nest in a *kokkobin*, level with the window of an inspection bungalow, and about ten feet from it. Sometimes both parents were away foraging for food at the same time, but usually they were away alternately, while the other one brooded the young. They always returned to the nest with empty beaks and fed the young by regurgitation.

Status.—Observed in every month. Very common during the rains and cold weather, but numbers gradually decreased during February until in March and April it was very seldom seen. During May and June numbers increased gradually, until it became very common again in July.

Dicrurus leucophaeus. The Pale Ashy Drongo.

Identification.—In the field the tail appears more widely and more deeply forked than the Black Drongo's.

Status.—Only observed in the area on four occasions, all between 27 November and 16 April, and on each occasion in the compound of an inspection bungalow.

Chaptia aenea. The Bronzed Drongo.

Status.—Only two observations. On 23 June 1932, two birds were seen flying from tree to tree, calling harshly, near Tantabin, at the tail of the Yeu Canal system. They were noticeably smaller than Black Drongos. On 28 October 1933, a single bird was seen in a tree on the Old Mu canal, and noted as no bigger than a Green Bee-eater.

Chibia hottentotta. The Hair-crested Drongo.

Status.—Observed twice only, in June and November. On the latter occasion it was perched among four King-Crows, and the stouter build was very noticeable.

Dissemurus paradiseus. The Large Racket-tailed Drongo.

Status.—Seen four times, all between 13 December and 25 March, three times in the Civil Lines at Shwebo. On one of them (10 March) the bird was much dishevelled, with both outer tail feathers missing, but identified from the conspicuous crest. Possibly it had been mobbed as an intruder to the area.

Acrocephalus stentoreus (? or **arundinaceus**). The Great Reed-Warbler.

Status.—Observed once only, in January, on reeds in Wetlet Lake, when a number of birds were present. Probably sub-species *brunnescens* (Indian race), as lower plumage was recorded as 'all white, with no sign of streaks'.

Orthotomus sutorius. The Tailor-bird.

Identification.—When perched, the tail is usually held straight out behind. From October onwards it is much shorter than during the rains; one record I made in December is of a party of several birds in full plumage, but with tails only about a quarter of the total length. A black spot on the side of the neck becomes conspicuous when the bird is calling.

Nesting.—On 19 October an adult with food in bill was twice seen visiting a bush; presumably feeding young, but nest was not found.

Status.—Observed in every month except January, but never very common.

Cisticola juncidis. The Streaked Fantail-Warbler.

Local name.—In the Mandalay district I have heard this bird called *nat-pi-so.*

Voice.—The usual call is reminiscent of two stones struck together, like a Chat's.

Habits.—Not found very retiring at any time of year. Frequently observed perched on grass stems, and in the cold weather flying short distances, calling the while, then settling. This contrasts with the mounting flights indulged in during the rains.

Nesting.—Nest-building observed 1 June at the earliest and 5 September at the latest. Nest sometimes 2 ft. from the ground.

Status.—Uncommon in November and not observed in December or January, but common in all other months.

Franklinia gracilis. Franklin's Wren-Warbler.

Habits.—Observed in paddy fields, both wet and dry, and in swamps; and I have seen it on a telephone wire. When perched, it sometimes jerks the tail in all directions as vigorously as it does in flight, and bobs the body up and down.

Status.—Observed only in June and September, and distinguished from Bevan's Wren-Warbler at that time of year by absence of the white eyebrow.

Phylloscopus affinis. Tickell's Willow-Warbler.

Identification.—In the field upper plumage appeared to me as olive-brown, not olive-green.

Status.—Observed on three occasions, in November and January, on tank bund and in inspection bungalow compounds. Identified by absence of wing bars, pale yellow lower plumage, and conspicuous yellow eyebrow.

Phylloscopus fuscatus. The Dusky Willow-Warbler.

Status.—Observed occasionally from November to February, not always in damp situations.

Prinia inornata. The Tenasserim Wren-Warbler.

Voice.—Call reminiscent of grasshopper or cricket, sustained sometimes for ten seconds or more without a pause; uttered both on perch and in flight, in the former case with the head thrown back; only heard during the rains.

Habits.—Very bold; it will approach within a few feet of one, in full view. I have seen it perched on a low palm tree, on a telephone wire, and among paddy stubble, as well as in more usual terrain, such as rushes and standing paddy.

Nesting.—A nest found on 28 September, at the top of a grass clump 18 ins. above water, contained one nestling and one egg. This nest was of the purse-shaped type, and very big for the contents.

Status.—Recorded in every month except April, and common during the rains.

Oriolus chinensis. The Black-naped Oriole.

Identification.—I found that wing and tail coverts of females and young birds showed more green than yellow in the field.

Voice.—Once in February, I heard a male calling with a harsh croak.

Habits.—Frequented bungalow compounds and open country near Shwebo. Young birds have been seen collecting caterpillars from the ground and taking them into trees to eat.

Nesting.—Female seen carrying nesting material as early as 11 April.

Status.—Observed in every month; noted as especially numerous in November.

Oriolus xanthornus. The Black-headed Oriole.

Habits.—Seen only in trees in inspection bungalow compounds and in thin jungle, never in open country or on the ground, like the Black-naped species.

Status.—Much less common than the Black-naped, but observed in all three seasons.

Sturnia malabarica. The White-winged Mynah.

Identification.—Distinguished from Jerdon's Mynah, when colour of bill was not noticeable, by the smaller size, the chestnut under tail, and the lighter grey wings. It is, too, a more shapely bird.

Habits.—Once observed hanging upside down while feeding. The flight is rapid.

Status.—Uncommon in the area; only observed in March, April and September.

Gracupica nigricollis. The Black-necked Mynah.

Habits.—Feeds sometimes on pipal buds. Occasionally collects in large flocks.

Nesting.—One nest seen was made mostly of straw, and another of sticks and straw. Nest building observed 21 August (latest).

Status.—Recorded in every month and noted as common in January, May and October.

Gracupica burmanica. Jerdon's Mynah.

Habits.—I have seen them, too, feeding on pipal buds.

Nesting.—I have seen nestlings being fed 10 August, latest. On one occasion in July, a pair was seen attacking a 3 ft. long snake, which was climbing a mango tree, presumably after their nest. They knocked it off the tree and continued to attack it as it made off.

Status.—Common in every month.

Acridotheres tristis. The Common Mynah.

Habits.—This species also feeds on pipal buds. In courting, the male erects his neck feathers and bows to the female.

Nesting.—Nest twice observed under eaves of houses, within 2 or 3 ft. of a Spotted Munia's. One nest, in which the young were being fed on 16 July, was being relined with sticks on 1 August. On 21 August the new brood was being fed with caterpillars, and they were still being fed on 2 September. On 29 September fresh sticks were being taken in, and by 7 October the third clutch was apparently being brooded. By 16 October the young were being fed, and were still being fed on 8 November. These dates give an incubation period of not more than 17 days, and a fledging period of at least 24 days.

Another nest was observed under construction on 7 November, while the earliest observation of nest-building was on 24 April. In the latter case, the young were being fed for several days before 13 May, again giving a probable incubation period of less than 17 days.

Status.—Common in every month.

Æthiopsar fuscus or ? **Æ cristatellus.** The Jungle Mynah.

Identification.—In many birds, the upper plumage was much browner than normal, the bill and legs much paler and the curl of feathers above the nostrils much less pronounced. Possibly some of these were young birds, but I have one record of a pair in that plumage which were feeding young. Probably the more common and darker birds were the Siamese race, and the less common and paler ones the Indian race.

Habits.—Frequently seen with cattle and buffaloes, often perched on their heads. I have seen them feeding on young pipal buds and on flowers of the cotton-tree. They were sometimes in mixed flocks with Jerdon's and Collared Mynahs. On 13 September 1933, at Shwebangon, many flocks were seen in flight, one of them comprising 70 to 80 birds.

Nesting.—The only nest observed in the area was on 12 June, when a pair were feeding young in a hole 12 ft. up in a *tanaungbin* in the open paddy fields. (This was the pair in the browner plumage referred to above.). On 21 August

one year a bird was seen in flight carrying what I thought to be food, but may have been nesting material.

Status.—Observed in every month. Recorded as common in September and November, and uncommon in February and March.

Æthiopsar albocinctus. The Collared Mynah.

Identification.—The tuft of feathers above the nostrils is much smaller than that of the Jungle Mynah. This is very noticeable in a mixed flock.

Habits.—On one of the two occasions that I saw it in the area I saw a flock of 6 to 8 birds, with 2 or 3 Pied Mynahs, on a bush in Wetlet Lake. On the other occasion there were large numbers in a cotton tree in full flower, in company with Jerdon's and Jungle Mynahs.

Status.—Only seen in January and February.

Surnopastor contra. The Pied Mynah.

Habits.—On one occasion in October I saw three birds together, and on another in February I saw a party of nine; otherwise I only saw them singly or in pairs. In January, at Wetlet Lake, birds were much more numerous than ever seen elsewhere in the area.

Nesting.—One nest seen, apparently complete, on 8 May. Another one was in a bungalow compound, 30 ft. up in a tree. Although this nest was very obvious, the birds were very cautious in approaching it. Only nine days before I saw young being fed, feathers were still being taken in for lining. Both birds chased away a magpie-robin which settled close by, but took no notice of a coppersmith.

Status.—Recorded in every month except July and August, but never common.

Ploceus infortunatus. The Eastern Baya Weaver-bird.

Identification.—Earliest signs of breeding plumage observed 17 April. Full breeding plumage recorded on 10 May (earliest), and on 9 September (latest). Some cocks still with traces of breeding plumage observed on 17 December.

Nesting.—Most of the numerous nests seen were overhanging water, but one solitary nest was overhanging a thorn bush. This was possibly regarded as an alternative means of protection against vermin. Nests were usually in colonies, but solitary nests were recorded on several occasions.

I have two records of nesting in company with the Striated Weaver-bird. In one case there was a finished nest of each species, each with three eggs, in the same bush.

In one colony building material was being taken mostly from plantain leaves, but partly from old nests and partly by stealing new material from other nests. One large colony of nests was built partly in a mango tree over a canal and partly in plantain trees alongside. I frequently found them suspended from the funnels of old nests, sometimes attached by the usual rope, sometimes attached directly, giving the appearance of a two-storied dwelling. In such cases, however, I always found the funnel closed by weaving, so that the upper 'storey' was no longer accessible. In one colony the process had in two cases been repeated twice, giving three storeys each. In one case the connection between the upper and middle 'storeys' was a rope and that between the middle and lower a funnel. In the other, both connections were funnels.

In one colony several nests had funnels at least 18 ins. long. In two cases the 'cock nests' of a colony were all found to have mud on the inside, whereas none of the finished nests contained any. In fact I have no record of a finished nest in the Shwebo district containing mud, and it appears to be unusual. In one colony observed on 23 September there was only one half-finished, or cock, nest. On the other hand, groups of old cock nests were seen on two occasions, with no finished nests nearby.

The earliest date on which finished nests were observed was 24 May, much rain having fallen during the month. Nest building was observed as late as

16 September. On 2 October one year a cock was still engaged in lengthening the funnel of a nest containing young, and a nest containing young was once seen on 19 October.

In one colony which I watched under construction the bulk of the work was done by the cocks. The hens only occasionally helped the cocks to weave, or did a little on their own. The hen would sometimes perch on the far side of the nest, and critically watch the cock at work. One day, on the other hand, I watched the hens of a colony busily feeding their young on grasshoppers, while all the cocks perched by the nests and tried to steal the food as it came in.

Status.—Except for one doubtful observation in January, I never saw this bird from November to March. In all other months it was common.

Ploceus manyar. The Striated Weaver-bird.

Identification.—Full breeding plumage observed on 10 May.

Voice.—I have heard them chattering noisily while nest-building.

Nesting.—I twice observed nests alongside Bayas' nests, once in a reed bed in Wetlet Lake, and the other time in *kaing*-grass at Kabo. Nests with the entrance at the side and with no funnel were seen on two occasions. In one of these cases the nest was also unusual in being suspended at two points only. This species sometimes, if not always, sticks dung instead of mud inside its nests. It is piastered along the inside edge of, I think, all cock nests, but of few, if any, egg nests.

A nest was observed under construction on 10 October, and I once found unfledged young in a nest on 9 November.

Status.—Observed in every month from May to November, but not outside that period.

Ploceïla chrysæa. The Golden Weaver-bird.

Identification.—Apart from the buff eyebrow, males in winter and females at all seasons were distinguished from the Eastern Baya by the darker upper plumage, and by the reddish brown tinge on cheeks, throat and breast. Earliest date of full breeding plumage was 25 May and the latest 15 November. Partial breeding plumage was seen as late as 17 December.

Habits.—Generally seen on vegetation growing in water or swamps, but once in the cold weather a large flock was observed on telegraph wires. A mixed flock of this species and Eastern Bayas was once recorded in November. It is sometimes very confiding.

Nesting.—I found that nests were built of much coarser grass or leaf strips than those of the other Weaver-birds, and lined with softer grass. The entrance was frequently furnished with a small porch of fine grass and was small for the size of the bird. One nest in a bush had just been begun by twisting strips of very tough grass or palm leaf round the twigs. Another, also in a bush, was suspended from two twigs.

On one occasion the female was bringing all the material for a nest, while the male perched nearby and displayed, both to her and, in her absence, to another female which had eggs. On other occasions, however, the male was seen at work.

Nest-building not observed before 16 June or after 20 September, but in Mandalay district I have seen it in progress on 18 October.

Eggs with darker spots, or mottled, were common.

Status.—Observed in every month between 25 May and 26 February, but never in March or April.

Munia atricapilla. The Chestnut-bellied Munia.

Identification.—Birds in immature plumage were once seen on 30 April—presumably young of the previous year.

Habits.—Generally found among rushes, also in long grass and paddy. Sometimes in company with Spotted and Red Munias. Seen feeding on grass seed.

Status.—Recorded in every month except February and May, but not very common, especially in the dry weather.

Uroloncha punctulata. The Spotted Munia.

Habits.—A flock of some hundreds was once seen in November, feeding on ripening paddy. A flock of a dozen, seen in September, was noted as very tame. On one occasion in April, some birds were seen roosting in a bush at dusk with a large flock of House Sparrows. On another occasion, also in April, several birds were in rushes with Chestnut-bellied and Red Munias.

Nesting.—Birds never seen singly or in pairs before 21 June, and nesting not observed before 10 July. In one case growing grass was picked and taken to an old mynah's nest under the eaves of my bungalow, but I do not think that eggs were laid in it. One nest was built under bungalow eaves within two or three feet of both a Mynah's and a House Sparrow's, and another almost touching a Mynah's. Other nests seen were 5 to 8 ft. up in small trees and in bushes in wet fields, and were sometimes very conspicuous. Materials were dead grass, green grass, straw and pampas grass, some nests being built entirely of one or other of the two last-named materials. When pampas grass was used, the white silky part was on the outside, giving the appearance from a distance of a large mass of cobwebs—a wonderful structure, with the egg cavity 5 or 6 ins. deep.

The birds sit very tight on their eggs; one remained on them while I shook the nest. A nest with 2 eggs was found on 6 November, on the 7th it contained 3, on the 8th 4. By 15 November there were 6. Another nest had 6 eggs and another about the same number. In a fourth case, however, there appeared to the touch to be at least 10.

15 November was the latest date on which eggs were found, but a nest with young was found on 28 November.

Amandava amandava. The Red Munia.

Habits.—Very tame. Flocks of up to 100 were seen out of the breeding season. Even during the breeding season, on 9 October, I once saw three adult males together. A number of birds were seen on 30 April one year in company with Spotted and Chestnut-bellied Munias, but there were no males in breeding plumage among them.

Status.—Uncommon, but seen in all seasons.

Passer domesticus. The House Sparrow.

Habits.—Large flocks were seen in March and April, as well as in the rains. Spotted Munias were once seen roosting with this species, and Pegu House Sparrows were seen in mixed flocks with them several times.

Nesting.—One nest, three feet up in a small thorn tree, had the entrance at the top, not at the side; the two eggs which it contained were so thickly mottled with dark brown that the background was hardly visible. Another nest, under the eaves of a bungalow, was about half finished in 24 hours from the start.

Status.—Seen in every month and common in most.

Passer montanus. The Tree Sparrow.

Habits.—I have seen them in the Mu river bed at Yeu and on the canal headworks at Kabo. They were not so common about buildings as in the Minbu district.

Status.—Observed in every month, but not so common as the House Sparrow, especially in the cold weather.

Passer flaveolus. The Pegu House Sparrow.

Habits.—Frequently found in and about bungalows, especially in the dry weather; it also frequented scrub jungle, paddy fields and toddy palms. In the rains and cold weather it was often in flocks of up to 30 or 40, occasionally in company with House Sparrows. Once, in April, I saw a pair hawking flies and returning to the same perch, just like flycatchers.

Nesting.—Nesting was observed in an old woodpecker's hole, in the rain gutter of my house, and in the ceiling of an inspection bungalow. Feathers

were seen being taken to all of these sites, and on one occasion a bird was seen walking about on the outside of a Pied Mynah's nest, with the owner inside, and stealing two or three feathers from it.

Status.—Observed in every month, and usually common.

Emberiza aureola. The Yellow-breasted Bunting.

Status.—One observation only, on 30 April 1933, when a party of three birds was seen on rushes in the Mahananda tank, near Shwebo town.

Delichon urbica. The House Martin.

Status.—Two observations, both in January 1934, at Wetlet Lake. On the 23rd of that month, numbers of birds were flying about over the reeds. On the 28th, a bird was identified flying about over shallow water with numbers of other swallows or martins.

Riparia riparia. The Eastern Sand Martin.

Status.—Two observations only. On 10 October 1932, a single bird was seen perched on grass in the water of the Mahananda tank. On 28 January 1934, a number of birds were seen, in company with Eastern Swallows and at least one House Martin, flying about over the shallow water of Wetlet Lake.

Riparia paludicola. The Indian Sand Martin.

Status.—I have no certain record of this bird in the Shwebo irrigated area. On four occasions, between 12 October and 13 April, birds were seen which were probably this species, but may possibly have been Eastern Sand Martins, of whose existence I was not at that time aware. On 13 April 1932, hundreds of birds, of one or the other species, were at nesting holes in the bank of the Mu at Yeu, while on 16 March 1933 I counted a flock of more than a thousand on a sand-bank at Kabo.

Hirundo rustica. The Eastern Swallow.

Habits.—In the N. Shan States in December I once saw them flying about in company with Wire-tailed Swallows.

Status.—Observed in every month of the year. On 22 June 1933, I saw a single bird. None had been seen earlier that month, so probably it was an exceptionally early arrival. Another was seen on 5 July of that year, and on 24 July large numbers of birds were recorded.

Unusually large flocks, probably on migration, were recorded in the area on 9 September, 26 March and 3 April. Outside the area, near Sagaing, a very large flock, evidently on migration, was observed on 23 May 1932, on the telegraph wires. There had been a monsoon storm the previous night, and they were very dishevelled, exhausted and tame, and busy preening themselves.

[A solitary bird was seen on 5 September 1932, at Wetlet, which was possibly of the western race, *rustica*. It was perched on a rush in a paddy field and was very tame. Close by, on a telegraph wire, were three or four Eastern Swallows, from which it differed in having the forehead ashy-grey and the breast and abdomen greyish-white tinged with pink. It appeared to be a young bird.]

H. r. tytleri. Tytler's Swallow.

No certain records of it from the irrigated area. The large flock of swallows seen near Sagaing on 23 May 1932, however, contained some of Tytler's as well as the Eastern race, and a solitary bird was seen flying about over the Irrawaddy at Kyaukmyaung on 22 April 1933.

Hirundo smithii. The Indian Wire-tailed Swallow.

Status.—Only observed once in the area, on 13 July 1932, when a party of three birds was seen in flight in the Shwebo Cantonments. (In the Mandalay canal area, in 1926-27, a pair was always to be seen at one particular spot,

but apart from them I only saw the bird in that area on one other occasion in the course of $3\frac{1}{2}$ years.)

Hirundo daurica. The Striated Swallow.

Status.—Only one observation, on 7 November 1931, when two or more birds were about the inspection bungalow at Thayetkan. There had just been 48 hours continuous rain from the north and one of the birds, although strong on the wing, was very tame, as if exhausted. This bird's plumage was rusty black, and it was possibly a young bird of Hodgson's race on migration.

Motacilla alba [ocularis Swinhoe] The Streak-eyed Wagtail.

Status.—Only observed once, on 12 November 1933. A single bird was feeding in the shallow water of a stream near Kyaukmyaung in company with a White-faced Wagtail. Identified by the grey line across the side of the head through the eye.

Motacilla alba [dukhunensis Sykes] The Indian White Wagtail.

Status.—Only one observation, on 13 October 1933. A single bird was seen on the bank of the Old Mu canal. Identified by white sides of head, grey crown and upper plumage, black chin and throat.

Motacilla alboides. Hodgson's Pied Wagtail.

Status.—Observed twice in the area, on 12 October 1933 and 5 February 1934. On the former date a single bird was feeding on a patch of floating rubbish in the Mu river at Kabo. On the latter date another single bird was seen feeding in the mud at the edge of the Mahananda tank. It frequently hovered over the water nearly motionless, and once perched on a stick. In the case of the first bird, the black ear-coverts were noted, and in the case of the second the black sides of the neck.

Motacilla leucopsis. The White-faced Wagtail.

Identification.—Birds with the all-black upper plumage of summer were seen on many occasions in the cold weather, e.g. 6 December, 12 January, 7 March.

Habits.—On one occasion I observed a number of birds in company with a single Grey Wagtail. Normally they do not appear to associate with other species. Birds were usually seen singly or in pairs, but occasionally in flocks. On one occasion at least 20 birds were seen roosting in a single bush with a White-breasted Kingfisher and three Pied Kingfishers. On two occasions birds were seen perched on telephone wires, and another bird was seen almost hovering over water, catching insects.

Status.—Very common throughout the cold weather. The earliest record was 16 September, birds being numerous by the 22nd. The latest observation was 23 April.

Motacilla cinerea. The Eastern Grey Wagtail.

Identification.—Most birds I saw had the chin, throat and upper breast white. In one, however, the throat and breast were suffused with yellow, in another the breast was yellow, divided by a white band from the yellow abdomen, and in a third the throat too was yellow.

Habits.—Nearly always seen singly and apart from other species. Once in the Mandalay district, however, I saw a bird in company with a White-faced Wagtail, and once in Shwebo another one among a number of that species.

Status.—Observed in every month from September to April, but not usually common. On 21 April, 1933, however, a large number of birds were seen along the edge of the Kadu Lake, possibly assembled for migration. Earliest date was 21 September, and latest 30 April.

Motacilla flava. The Grey-headed Wagtail.

Habits.—Usually seen singly, but occasionally in flocks of up to 20. A bird was seen one October feeding with Indian Pipits. On several occasions birds were seen walking about on floating vegetation.

Status.—Usually rather uncommon, but on three occasions, in November, January, and April, numerous birds were observed at the edges of lakes. Earliest date 4 September, latest 10 May.

Motacilla citreola. The Yellow-headed Wagtail.

Identification.—I saw a pair in full summer plumage on 8 April one year.

Habits.—I once saw this bird hawking insects just like a flycatcher and on another occasion continually hovering just over the surface of a lake. On several occasions I saw them on floating vegetation, a habitat of which this species seems to be particularly fond.

Status.—Single birds and pairs fairly common in the area, and on two occasions I found them numerous at the Wetlet Lake. I never saw one earlier than 10 November; my latest date was 8 May.

Dendronanthus indicus. The Forest Wagtail.

Status.—On 26 April 1933, I saw 3 birds feeding along the water's edge of the Mahananda tank, on the outskirts of Shwebo town. The plumage and the very curious sideways swaying of body and tail were unmistakeable. One bird was still at the same spot on 27 April and again on the 30th.

Anthus hodgsoni. The Indian Tree Pipit.

Status.—Not very common. Earliest date 7 November, latest 30 April.

Anthus rufulus. The Indian Pipit.

Identification.—Easily distinguished from the Burmese Bush Lark, which is also very common in the area, by the white edges to the tail.

Habits.—Not usually in flocks, but I once saw one of 30 to 40 birds in a wet fallow field in September. The bird was seen once or twice on sand-banks in the River Mu, which had little or no vegetation on them.

Status.—Common most of the year, though not so noticeable in the hot weather. Very large numbers were sometimes seen, especially round the Wetlet Lake and the Mahananda tank.

Alauda gulgula. The Small Skylark.

Identification.—The small dark crest is sometimes visible in the field, distinguishing it from the Burmese Bushlark.

Status.—Only observed five times in this area, three of the occasions being in December, one in March and one in May. On the latter occasion a pair was seen copulating, but no nest was ever found.

Calandrella raytal. The Ganges Sandlark.

Identification.—More than once I observed a small crest erected at intervals, especially when agitated.

Voice.—I once saw a bird singing high up in the air, after the manner of a skylark. On another occasion I recorded the voice, when in flight, as a trilling song.

Status.—Only seen in the bed of the River Mu, where it was fairly common in the dry weather. I never observed it between 17 August and 5 January.

Mirafra assamica. The Burmese Bushlark.

Voice.—Once in October I saw a bird calling with a monosyllabic pipe. On another occasion, also in October, I watched one chirping loudly while gradually approaching its nest. I have also seen it singing lustily from the extreme top of a *tanaungbin* instead of from the usual bush.

Nesting.—The nest referred to above was found as late as 6 October, and contained two nestlings. Pairing was observed as early as 3 April, and display on 13 April. In the latter case the bird was running about excitedly, stretching to its full height, bowing and singing, though the female was not to be seen.

I saw four nests in the area, all on the ground, two being concealed under low shoots of small trees, one under a tiny shrub, and one in a clump of rush stubble. All had the opening at the side and one at least had coarse grass on the outside and finer grass inside.

One of the four nests contained three young and another three eggs, so that a clutch of three does not appear to be very rare.

Status.—Recorded in every month. Fairly common.

Cinnyris asiatica. The Purple Sunbird.

Identification.—The earliest date I saw signs of breeding plumage was 18 November and remnants of it were seen as late as 15 August, in the shape of a little purple still visible on the flanks. The earliest and latest dates of full breeding plumage were 16 December and 22 June. Earliest signs of non-breeding plumage (viz. breast turning light in colour) were seen on 6 June and the latest on 16 December when a male was seen with still no sign of breeding plumage. The earliest date of full non-breeding plumage was 22 June, though a bird seen on 10 June had almost acquired it.

It seems that when breeding plumage is shed the whole lower plumage of the male turns yellow before the violet stripe is acquired, for I have seen a male on 10 July with the stripe extending only to the centre of the breast, and others on 14 August with only a dark patch at the base of the throat.

On one occasion in April I saw a pair with an obvious young bird, in which the lower plumage was a much brighter yellow than that of the mother, instead of the usual duller shade.

Voice.—I recorded this once as a 'loud, harsh, monotonous whistle'. On another orcasion, in May, a male chasing a female was calling loudly and continuously 'very like a tailor bird'.

Habits.—This bird seemed particularly fond of *kokkobins* and of bushes with yellow trumpet-shaped flowers, which I believe are allamandas. The latter are common in bungalow compounds, and were sometimes full of these birds. I once saw a male hovering, with its bill in the green foliage of a tree, just as if it were at a blossom. No doubt it was hawking insects. On another occasion I watched a pair making frequent sallies after flying insects from the top of a tall tree.

Nesting.—One nest I found (in Mandalay) was built only 18 ins. from the ground. The female on another one sat tight until I had approached to within a few feet.

Status.—Observed in the area in every month, but uncommonly from December to April.

Dicaeum cruentatum. The Scarlet-backed Flowerpecker.

Identification.—The steel-blue gloss on the wings was sometimes conspicuous. In one male which I saw, the whole lower plumage appeared pure white, not buff.

Voice.—A female I saw in January was calling loudly, very much like a tailor-bird. The *tchik-tchik* call is surprisingly loud for the bird's size.

Habits.—Once near Maymyo I saw a male hovering motionless in the air, to catch a flying insect. I mistook it at first sight for a butterfly. It had just been raining heavily and the bird then flitted about the wet trees, continually shaking rain drops off its wings. A male which I watched in the Shwebo area was flitting about a mango tree, sometimes on the lowest branches only a few feet from the ground.

Status.—Only observed three times in the area, all between November and January.

Picus viridanus. The Scaly-bellied Woodpecker.

Status.—Only observed three times in the area, a pair in February, and single males in June and July.

Picus canus. The Black-naped Green Woodpecker.

Status.—Seen once only, a single female in November, moving from stem to stem of toddy palms near Pauktaw inspection bungalow.

Dryobates mahrattensis. The Yellow-fronted Pied Woodpecker.

Habits.—Once observed feeding on a rope of creeper in scrub jungle at Shwebo, and running up *and down* with equal ease.

Status.—Only identified five times in the area, in September, October, March and April. Distinguished from the Fulvous-breasted, the Siamese Pied, and the Burmese Pigmy species either by the dark stripe on the side of the neck, the crimson on the abdomen, or both.

Micropternus brachyurus. The Rufous Woodpecker.

The only bird I identified in this area (on 8 April 1932) was drumming on a dead bark-less branch of a tree near the Yeu canal. The noise was similar to that of a branch creaking in the wind. It once uttered a succession of screaming notes, rather like a Pied Kingfisher. On a previous occasion, in the same locality, I had seen a Woodpecker, too far off to identify, drumming on a large tree and producing the same curious noise. This puzzled me until I saw the bird, as it was just like the creaking of a large bough, but there was no wind. The noise was tremendous for so small a bird. I have seen the bird several times in the Mandalay canal area.

Dinopium javanense. The Golden-backed Three-toed Woodpecker.

(? or the Himalayan **Dinopium shorii**).

Only seen twice in the area, in February and October, both times along the Old Mu canal. Distinguished from Tickell's species, which I have seen in other districts, by the smaller size, which was noted on each occasion as that of a Rufous Woodpecker.

Iynx torquilla. The Wryneck.

Identification.—The black line from the crown, ending in a black patch on the back, was usually conspicuous, and a black line through the eye down the side of the neck, sometimes so. I have, however, seen birds in September and October with these markings very faint.

Habits.—Most birds which I saw were solitary, but on 9 April one year I saw two together, and on 19 October two birds in a tree with a third in a bush close by. I did not find the bird shy or elusive. More than once I watched it feeding in the compounds of occupied bungalows, in one case while my dogs were running about. One note of a bird on the ground records it as 'very tame', while on another occasion a bird in a *tanaungbin* allowed me to approach within a few yards without leaving the tree.

I have watched it feeding on ants on a branch, and sometimes among dead leaves on the ground.

Status.—Observed fairly commonly in every month from September to April. Earliest date 12 September, latest 20 April.

Megalaima haemacephala. The Coppersmith.

Voice.—Although the bird is not so vocal in the cold weather as in other seasons, I have heard it calling in every month from November to February. During an unusually cold spell in December 1933, I noted it one day as calling loud and long in its usual tempo. In the previous month I had heard a bird calling much more slowly than usual, with a pause of about two seconds between each note. On one occasion in June I watched a bird calling in a jerky, irregular fashion instead of with the usual monotonous regularity.

Habits.—Usually stationary on its perch, but once in November I saw two birds running about the branches of a small tree. I twice observed birds feeding on berries. In one case, in March, they were being brought by one of a pair to its mate, which was perched on a branch and calling. The two berries which comprised the offering entirely filled the bill of the bird bringing them.

Nesting.—Of the two nests which I observed in use, one was 25 ft. up in the branch of a mango, and the other about 30 ft. up in a broken branch of a

kokkobin. The latter had two entrance holes 18 ins. apart. One nest was in use on 14 February, and young were being fed in the other on 10 April.

Status.—Observed in every month. Fairly common.

Cuculus canorus. The Khasia Hills Cuckoo.

Status.—The only birds I saw in the area were two or three young ones which were round and about the Wetlet inspection bungalow on 8 and 9 October, 1933. When first seen on 8 October, two birds were feeding on worms or caterpillars in a fallow field with two Pied Crested Cuckoos. At intervals they perched on bushes and were not at all shy. On 9 October two or three birds were about the compound all day. Upper plumage was grey-brown with bars, lower plumage white with narrow bars, and one at least had a white nuchal spot and a white spot on the forehead. Feet were bright yellow, iris orange, and bill dark at tip, orange at base.

Hierococcyx fugax. Hodgson's Hawk-Cuckoo.

Status.—On 18 January 1934, at Kabo, a bird settled two or three feet up in a bush on the Mu river bank, immediately above a grass Owl which had just settled on the ground. Identified by size, which was larger than the Plaintive Cuckoo, powdery blue head and upper plumage, greyish-white lower plumage, and black bill.

Cacomantis merulinus. The Plaintive Cuckoo.

Identification.—The barring on the tail was usually a conspicuous feature. I once saw a partially albino bird, with a white patch on the left wing. Once or twice I mistook them at first sight for Wrynecks.

Habits.—Birds were seen several times perched on telephone wires, twice clinging to rushes, and once on the fence of a bungalow compound. Most birds I saw, however, were on bushes. I have seen them eating worms and once a caterpillar, which the bird shook vigorously before swallowing whole.

Status.—Common in the cold weather, but never seen between 10 April and 30 September. On 28 November, 1933, I found birds very numerous in paddy fields at Myittaw, and on 18 March 1933 they were almost the commonest bird seen during the morning, 'very large numbers' being recorded. Possibly they were assembling for migration to the hills.

Clamator jacobinus. The Pied Crested Cuckoo.

Habits.—I once saw two birds feeding on worms in a fallow field. Always seen singly, except for several occasions in September and October when I saw two together.

Status.—Fairly common in the rains, but never seen between 9 November and 26 May. In September 1933 I found them commoner than usual. Birds in immature plumage were seen on 14 October and 9 November.

Clamator coromandus. The Red-winged Crested Cuckoo.

Identification.—From the side, the white collar is conspicuous. In flight the long tail undulates like that of a Paradise Flycatcher.

Habits.—Two birds seen together on one occasion, otherwise always seen singly.

Status.—Uncommon. Only six observations, all between 19 July and 16 November.

Eudynamis scolopaceus. The Koel.

Identification.—At least one female which I saw had chin, throat and breast dark brown, striped and spotted with white, instead of vice versa.

Voice.—I never noticed the female's *kik-kik-kik* call, but more than once saw one uttering a monosyllabic screech. Twice, in different localities, I heard a bird calling on 1 February, and in 1934 birds were calling frequently by 5 February.

I several times heard birds calling in August and September and once on 4 October. A male seen on 19 July was calling very hoarsely.

Habits.—I have one record of a male feeding on the ground, in a patch of scrub jungle; also of one bird of a pair feeding the other in a neem tree. A female was once seen in a young pipal tree, picking large berries and swallowing them whole.

The bird seen calling hoarsely on 19 July was perched in full view, unlike its usual furtiveness, but was ignored by several crows in the same tree.

Status.—Recorded in every month from February to October. Commonest in March, April and May, but there were numbers about on 3 July 1932. Not seen or heard between 4 October and 1 February.

Rhopodytes tristis. The Large Green-billed Malkoha.

Identification.—In size, shape and flight, the bird often reminded me of a Red-billed Blue Magpie. In the field the whole plumage, except the white tips to the tail feathers, sometimes looked very dark grey or black.

Habits.—I once saw a bird jumping about a tree like a squirrel. I usually found it very shy and skulking, but once saw one on the drive of a bungalow in Shwebo.

Status.—Only six observations in the area, in March, June, October and November; also one in April at Kyaukmyaung, on the Irrawaddy near by.

Centropus sinensis. Hume's Crow-Pheasant.

Voice.—Once heard calling on a very hot April evening, when most birds were silent and still.

Habits.—Fairly often seen in trees, twice in full view on the top of one.

Status.—Recorded in every month; comparatively uncommon in the cold weather.

Psittacula eupatria. The Large Parakeet.

Status.—Only seen once in the area, on 23 March, 1932.

Psittacula krameri. The Rose-ringed Parakeet.

Habits.—I have seen birds feeding on neem fruit in May, and on their seeds in June.

Once, at the end of January, I watched a male pecking at a female's head and pawing with one foot, just like a puppy at play—presumably courting.

Birds were usually seen singly or in twos or threes, even out of the breeding season; on the other hand, I have seen flocks in March and April.

Status.—Observed in every month except December. Usually common, but not recorded between 2 November and 16 January.

Coracias benghalensis. The Roller.

Voice.—One of a pair seen in a tree on 10 June was uttering a very faint whining note.

Habits.—I twice saw birds feasting on a swarm of flying insects in company with other species.

Nesting.—No nests found, but on 8 May 1933 a bird appeared, from its behaviour, to be nesting in a *kokkobin,* and on 20 June 1933 an evident young bird was seen.

Status.—Observed in every month. Usually common, but less in evidence from February to May.

Eurystomus orientalis. The Broad-billed Roller.

Status.—Only seen once, and then not in the irrigated area, but a little outside it, in the jungle close to the Shwebo-Kyaukmyaung road.

Merops orientalis. The Green Bee-eater.

Identification.—On two occasions, both in September, birds were noticed with a much lighter chestnut crown than usual.

Habits.—Flocks were recorded in May, June and October, one in June being a large one.

Nesting.—No nests observed in this area, but copulation once seen, on 30 September. In the Mandalay district this species and the Blue-tailed were seen together in May at nesting holes in the vertical bank of the Thapangaing outfall channel of the Mandalay canal.

Status.—Observed as common in every month, but not so numerous from February to June as at other times.

Merops superciliosus. The Blue-tailed Bee-eater.

Habits.—On one very hot oppressive evening in April, when most birds evidently found it too hot to move, numbers of these birds were hawking insects very actively. I have more than once seen them hawking from a perch on telegraph wires.

I once saw one catch a large dragon-fly, which it swallowed whole.

Nesting.—I saw birds at nesting holes in the Mu river bank at Yeu on 22 April 1932. On 21 May my presence excited the birds greatly for some reason, numbers wheeling round my head, accompanied by Common and Black-bellied Tern and by one or two Little Pratincoles. The birds were still there on 5 June, although the river had in the meantime been nearly up to the holes. In June of the following year I saw a nesting colony in the bank of a canal near Shwebo, within 20 yards of which people were continually passing. As noted under Green Bee-eaters, I once saw both species nesting together in the Mandalay district.

Status.—Earliest date 6 April, latest 10 November. Seen in all months between those dates, but rather local. In favoured localities, such as the Wetlet lake and the Mahananda tank, I found them numerous from July to October. On 6 September 1933 I saw an unusually large flock, of 200 to 300, on telephone wires at Wetlet.

Alcemerops athertoni. The Blue-bearded Bee-eater.

Status.—Only seen once in the area, on 27 November 1932, when two birds were observed perched high up in a cotton tree in the compound of Tazé inspection bungalow.

Ceryle rudis. The Pied Kingfisher.

Habits.—I once saw a bird dive ten times without catching anything, and on another occasion I saw one make a slanting dive, instead of the usual vertical one. Birds were usually seen singly or in pairs, but parties of up to five were seen occasionally. Three or more birds were seen on one occasion roosting in company with a White-breasted Kingfisher and at least 20 Wagtails (Alba) in a small bush, growing in the water of the Old Mu canal. In Mandalay I have seen a bird fishing in the moat of Fort Dufferin, and once, in March, saw a party of five there.

Nesting.—No nests definitely observed in the area, but on 10 May 1931 three birds objected strongly to my presence near some holes in the Mu river bank at Yeu.

Status.—Recorded in every month. It seemed to get very scarce in September for some reason, a phenomenon which I noted in the Minbu district also.

Alcedo atthis. The Common Kingfisher.

Habits.—On 22 April one year I watched a bird at a stagnant pool in company with four species of Stork, three or four species of Egret, Common Herons, Pond-Herons, a Common Sandpiper, and a Brahminy Kite. The Kingfisher held its ground at my approach until all except the Kite and the Pond Herons had left.

I once saw a bird settle for a few seconds on a road, picked up a winged insect, and fly up to a perch to swallow it.

Status.—I never saw this bird in the area between 22 April and 10 August. (I later noticed the same phenomenon in the Minbu district). For the rest of the year, it was seen in every month, being numerous in September, October, and November.

Ramphalcyon capensis. The Stork-billed Kingfisher.

Status.—Never observed between 8 April and 20 September, and not very common during the rest of the year, though seen in every month. I noted it as commoner than usual in early February 1933, and in mid-January 1934.

Halcyon smyrnensis. The White-breasted Kingfisher.

Habits.—I once saw a bird roosting in a small bush in company with three or more Pied Kingfishers and twenty or more Wagtails (*M. alba*). Usually seen near water.

Nesting.—The only nest I saw was on 10 May 1931, in the bank of the R. Mu at Yeu. One parent was catching small fish, and taking them into the tunnel, which was more than two feet long.

Status.—Observed in every month except April. Their numbers seemed to vary curiously during the year. In January and February 1933 they were numerous. On 9 February 1933 about 15 were counted along the Shwebo canal between Kabo headworks and Shwebo. During the same trip on the following 3 April, however, not a single bird was seen, and the bird was not seen again in the area until 8 June. By 19 July they had become very numerous again, especially perched on telephone wires. None were seen during August, but on 22 September they were once more numerous. October again was a blank month, but by 25 November they were 'very numerous indeed'.

Anthracoceros malabaricus. The Pied Hornbill.

Status.—Not observed in the area, but I record here an observation made on 6 January 1929 along an irrigation channel from the Taunggan tank, Mandalay district. A single bird was perched on top of a dead tree. Its occurrence in cultivation in the plains appears to be unusual.

Upupa epops. The Hoopoe.

Habits.—I have two records of birds dust-bathing.

Nesting.—None observed.

Status.—Seen in every month, but uncommon from March to May. Birds seen on 18 April 1931 and 2 April 1933 were noted as the first seen for a long time, and none were seen between the latter date and 31 May 1933. By 23 June that year they had become fairly common again, and by 19 July were numerous. Even out of the breeding season, birds were seen more often singly or in couples than in parties. Young birds (with the fawn in the plumage undeveloped) were only seen once. This was on 22 July 1932 when two or three were with their parents on the Shwebo golf-course, the birds being unusually timid.

Cypsiurus parvus. The Palm Swift.

Habits.—At least three times I saw flocks well away from toddy-palms,—half a mile or so in one case. One of these, seen on 21 March flying about over the Mahananda tank, was probably a thousand strong.[1] The air was thick with birds. I once watched another flock of about 100 flying to and fro some 20 ft. above a fallow field surrounded by paddy stubble. They were evidently hawking insects, but the latter were so small as to be invisible even from a distance of a few feet.

Voice.—All the three flocks seen away from palms were quite silent.

Status.—Seen in every month. Common.

Hemiprocne coronata. The Indian Crested Swift.

Status.—Observed once, in the jungle near Kyaukmyaung on the Irrawaddy, when a flock was flying about high up. They were recorded as no bigger than Palm Swifts, but had the breast and abdomen white, so that I have no doubt that the height caused me to underestimate the size and that they were actually this species. Later, in the Minbu district, I got to know the bird well.

(*To be continued*)

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[1] *Collocalia?*—Eds.

FISHES OF THE KUMAON HIMALAYAS

BY

A. G. K. Menon, M.A., Research Scholar

(*With a text figure*)

(Communicated by Dr. S. L. Hora, Director, Zoological Survey of India)

Introduction

Though angling in the Kumaon Lakes is a popular pastime for lovers of sport in these invigorating hills, our knowledge of their fish fauna is very meagre indeed. The first record of any fish from this region is by Day[1] who in 1878 noted that the Naini Tal specimens of *Barbus conchonius* 'have the dorsal spine much less coarsely serrated than those from the plains, from whence they were introduced not many years since; they have also a darkish band along the side'. Walker[2] (p. 17) gave the following list of the Naini Tal fishes, based on identifications made by the Curator, Indian Museum, Calcutta:—

(1) *Barbus tor* (Mahseer).
(2) *Barbus chilinoides* (the lake fish) or 'Kali Macchi'.
(3) *Barbus conchonius*.
(4) *Barilius bola* (Hill trout).
(5) *Ophicephalus gachua* (Murrel).
(6) *Oreinus sinuatus* (Risala).

For introducing Mahseer in the lakes, Walker (p. 103) pays a well-deserved tribute to Sir Henry Ramsay and narrates the following history of their introduction here:—

'The public are indebted to Sir Henry Ramsay for the mahsir fishing in the Kumaon lakes. On account of the steep falls at or below the outlets of all the lakes, except Malwa-tal, no mahsir could possibly have got unaided into them. Into Malwa-tal it is possible that fish could get at most seasons from the Gola river.

'About 30 years ago Sir H. Ramsay had some small mahsir carried up from the Gola in earthen-ware *Ghurras* to stock Bhim-tal, Naukuchia, and Sat-tal, and from the Kosi river to stock Nainital.

'These young fish prospered in Naini-tal, in Sath-tal and in Naukuchia, but they failed in Bhim-tal. For upto 1873 I never saw nor heard of a mahseer being caught in Bhim-tal.

'Later however (I think in 1878), Sir H. Ramsay again made an effort to introduce mahsir into Bhim-tal, and this time with success. The fish are now flourishing in Bhim-tal, as well as in many of the other lakes. I have myself caught mahsir in Bhim-tal, weighing 8 lbs, and I am aware of one having been caught on a live-bait, which weighed 18 lbs.'

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[1] Day, F., Fish. India, p. 576 (1878).
[2] Walker, W., Angling in the Kumaon Lakes, p. 103 (1888).

'As regards "Kali-macchi"—"Lake fish or Kurnkutla", I cannot get information of any period at which they did not exist in the lakes, but whether they were introduced in pre-historic times or like Topsy "growed" there, I cannot say'.

I have quoted extensively from Walker's, 'Angling in the Kumaon Lakes' for two reasons, firstly this work is not available in any of the research libraries and secondly these facts are of great historic importance in the study of the Kumaon fishes.

The next record of fish from the Kumaon Lakes is by Sundara Raj[1] who stated:—

'From all reports these isolated lakes had hardly any fish in them before the introduction of Mahseer by Sir Henry Ramsay, a well-known commissioner of Almora from 1856-84. The comparative barrenness of waters at this elevation is a characteristic feature of the Indian hills'.

'The only other fishes found in these lakes at present are:—

(1) *Barbus* (*Tor*) *cheilinoides* McClelland.
(2) *Barbus* (*Puntius*) *conchonius* Hamilton.
(3) *Raiamas bola* (Hamilton).
(4) *Barilius bendelisis* (Hamilton).
(5) *Oreinus sinuatus* (Heckel).
(6) *Nemachilus rupicola* (McClelland).
(7) *Ophicephalus gachua* (Hamilton)'.

In May-June 1948 a party of the Zoological Survey of India surveyed the fauna of a part of the Kumaon Hills and made extensive collections in the Naukuchia, Bhim-tal, and several rivers and streams and casual collection in the Sath-tal and Naini-tal. Over a thousand specimens were collected. In the lakes, besides the Mahaseer, *Barbus* (*Tor*) *putitora* (Hamilton), the following other species were obtained:—

Barbus (*Puntius*) *ticto* (Hamilton).
Barilius bendelisis (Hamilton).
Oreinus plagiostomus (Heckel).
Ophicephalus gachua Hamilton.

It is inferred, therefore, that *Barbus* (*Tor*) *cheilinoides, Barbus* (*Puntius*) *conchonius* and *Raiamas bola* of the earlier lists are either now absent from the lakes or are very rare and that *Barilius bendelisis,* and *Barbus* (*Puntius*) *ticto* have been recently introduced into the lakes. The explanation of the absence of certain fish earlier known from the lakes is to be found in the habits and associations of some of these fishes. Walker (p. 35), giving his experience of fishing in the Naini-tal, stated:—

'When I first angled in Naini lake, in 1863 and 1864, there were comparatively few large mahsir in it, there were shoals of lake fish (*Barbus chilinoides*) and many small trout (*Barilius bola*). A mornings catch would include a couple of small mahsir, eight or nine 'lake fish' and two or three trout. Gradually the mahsir have reduced the number of other fish until it is a rare circumstance to catch a lake-fish with the fly, and I have not for many years seen a single trout, although I heard of one being caught last year by a troller'.

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[1] Raj, Sundara B., *Proc. Nat. Inst. Sci. India,* xi, pp. 341-342, 346.

Besides the ravages of the predatory mahseer, he attributed the disappearance of the trout from the lake to its breeding habits. He stated (p. 37):—

'I have written only of the Mahasir in the Naini lake because they now reign supreme having practically as far as fly-fishing is concerned, cleared out every other kind of fish. The instinct of the trout, which led it in autumn to crowd round the mouth of the streams which enters the lake at its western end, accelerated its disappearance: for I have in former years often seen the natives lifting them out with sheets in thousands as they pressed on each other in their anxiety to get up stream. The persistence with which this instinct remained in the Baril is in strange contrast to the complete annihilation of the migratory tendency in the lake mahsir'.

Again in his account of the Bhim-tal, Walker (p. 52) stated that 'without doubt the mahsir have lessened the numbers of the lake fish; but there is as little doubt that the protection of the fish from poachers is too intermittent to secure the interests of the honest angler'.

Leaving aside the fish fauna of the lakes, which appear to have been artificially stocked at one time or another, the first account of the fish of the Kumaon Himalayas is given by Hora[1]. The material on which this account is based was obtained by Messrs. E. O. Shebbeare and M. P. Bhola from the Nandhaur and Kalaunia rivers, which were not visited by us. It comprised 17 species, of which 11 are represented in the collections made from the Kosi and Gola rivers. The following species are not represented in the present collection:—

(1) *Brachydanio rerio* (Hamilton).
(2) *Barbus chilinoides* McClell.
(3) *Barbus conchonius* (Hamilton).
(4) *Lepidocephalus guntea* (Hamilton).
(5) *Glyptothorax pectinopterus* (McClell.).
(6) *Amblyceps mangois* (Hamilton).

The following species found in the present collection were not represented in the collection from the Nandhaur and Kalaunia rivers:—

(1) *Oreinus plagiostomus* (Heckel).
(2) *Labeo dyocheilus* (McClell.).
(3) *Barbus* (*Puntius*) *ticto* (Hamilton).
(4) *Nemachilus rupicola* (McClell.).
(5) *Botia almorhae* Gray.

Taking the lakes and the streams of the Kumaon Hills together, it would appear that 23 species have been recorded so far, of which one, *Raiamas bola* (Indian Trout) has not been found in recent years and many have died out altogether. The fish fauna as now known, is listed below:—

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[1] Hora, S. L., *Rec. Ind. Mus.* xxxix, pp. 338-348 (1937).

LIST OF FISHES KNOWN FROM THE KUMAON HIMALAYAS

Scientific Name and Systematic Position of species	Reference	Number, size and locality of specimens in the recent collection	Distribution
Cyprinidae			
Sub fam. Rasborinæ			
1. *Barilius bendelisis* (Ham.)	Day, *Fish. India*, p. 590, pl. cxlviii, Figs. 7, 8, 9 (1878).	60 specimens: 6 to 14·4 cm. Naini-tal stream, Bhim-tal and Kosi river (Khairna).	Along the base of the Himalayas and throughout the continent.
2. **Barilius* (*Raiamas*) *bola* Ham.	Hora, *Rec. Ind. Mus.* xxxviii, p. 138 (1936).	...	Hilly parts of Punjab, U. P., Orissa, Assam, Bengal and Burma.
3. *Barilius vagra* (Ham.)...	Day, *Fish. India*, p. 598, pl. cxviii, Fig. 3 (1878).	13 specimens: 2·6 to 9·7 cm. Kosi River (Khairna).	Rivers of Himalayas, Assam and Sind Hills.
4. **Brachydanio rerio* (Ham.)	Hora, *Rec. Ind. Mus.* xl, p. 173 (1938).	...	Throughout India and Burma.
Sub fam. Cyprininæ			
5. **Barbus* (*Puntius*) *chilinoides* McClell. ...	Day, *F.B.I.* p. 307 (1889).	...	Along the Himalayas upto Assam and Ganges.
6. **Barbus* (*Puntius*) *conchonius* (Ham.)	Hora, Misra & Malik, *Rec. Ind Mus.* xli, p. 278 (1936).	...	Deccan, N. W. Provinces, Punjab, Bengal and Assam.

7.	*Barbus* (*Puntius*) *ticto* (Ham.)	Hora, Misra and Malik, *Rec. Ind. Mus.* xli, pp. 263–297 (1939).	220 specimens: largest 6·8 cm. Naukuchya-tal, Bhim-tal, Naini-tal and Kosi rivers.	India, Burma and Siam; very widely distributed.
8.	*Barbus* (*Tor*) *putitora* (Ham.)	Hora, *Journ. Bombay Nat. Hist. Soc.* xli, pp. 277–284 (1939).	100 specimens: largest 1½ ft Naukuchya-tal, Bhim-tal Sat-tal and Kosi river.	All along the Himalayas.
9.	*Crossochilus latius* (Ham.)	Mukerji, *Journ. Bombay Nat. Hist. Soc.* xxxvii, p. 50 (1934).	5 specimens: largest 19 cm. Kosi river (Khairna).	Peninsular India, along the Himalayas and Burma.
10.	*Garra gotyla* (Gray) ...	Hora, *Rec. Ind. Mus.* xxii, p. 653 (1921).	3 specimens: 15 cm. each. Kosi river (Khairna).	All along the base of the Himalayas.
11.	*Garra prashadi* Hora ...	Hora, *Rec. Ind. Mus.* xxxix, pp. 338–340 (1937).	4 specimens: largest 12 cm. Kosi river (Khairna).	Endemic in the Kumaon Hills.
12.	*Labeo dero* (Ham.) ...	Hora, *Rec. Ind. Mus.* xxxviii, pp. 314–315 (1936).	8 specimens: largest 25 cm. Kosi river (Khairna).	All along the Himalayas, Sind Hills, Assam, Burma and Ceylon.
13.	*Labeo dyocheilus* McClell.	Hora, *Rec. Ind. Mus.* xxxviii, pp. 320–321 (1936).	2 specimens: 18 and 31 cm. Kosi river (Khairna).	All along the Himalayas, and Sind Hills.
14.	*Oreinus plagiostomus* (Heck.)	Misra, *J. Zool. Soc. India*, I, pp. 39, 40 (1948).	80 specimens: largest 72 cm. Kosi river (Khairna) Naini-tal lake and Bhowali Nalla.	Afghanistan and Kashmir.
	COBITIDAE			
15.	*Botia almorhae* (Gray)...	Hora, *Rec. Ind. Mus.* xxiv, pp. 320–321 (1922).	3 specimens: largest 15·1 cm. Kosi river, Almorha.	Khasia and Almorha Hills.
16.	**Lepidocephalus guntea* (Ham.).	Hora, *Rec. Ind. Mus.* xl, p. 177 (1938).	...	Throughout northern India.
17.	*Nemachilus beavani* Gunth.	Hora, *Rec. Ind. Mus.* xxxix, p. 341 (1937).	47 specimens: 2 to 7.7 cm. Kosi and Gola rivers.	All along the eastern.

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2. **Barilius* (*Kaiamas*) *bola* Ham.	Hora, *Rec. Ind. Mus.* xxxviii, p. 138 (1936).	...	Hilly parts of Punjab, U. P., Orissa, Assam, Bengal and Burma.
3. *Barilius vagra* (Ham.)...	Day, *Fish. India*, p. 598, pl. cxviii, Fig. 3 (1878).	13 specimens; 2·6 to 9·7 cm. Kosi River (Khairna).	Rivers of Himalayas, Assam and Sind Hills.
4. **Brachydanio rerio* (Ham.)	Hora, *Rec. Ind. Mus.* xl, p. 173 (1938).	...	Throughout India and Burma.
Sub fam. Cyprininæ			
5. **Barbus* (*Puntius*) *chilinoides* McClell. ...	Day, *F.B.I.* p. 307 (1889).	...	Along the Himalayas upto Assam and Ganges.
6. **Barbus* (*Puntius*) *conchonius* (Ham.)	Hora, Misra & Malik, *Rec. Ind Mus.* xli, p. 278 (1936).	...	Deccan, N. W. Provinces, Punjab, Bengal and Assam.
7. *Barbus* (*Puntius*) *ticto* (Ham.)	Hora, Misra and Malik, *Rec. Ind. Mus.* xli, pp. 263–297 (1939).	220 specimens: largest 6·8 cm. Naukuchya-tal, Bhim-tal, Naini-tal and Kosi rivers.	India, Burma and Siam; very widely distributed.
8. *Barbus* (*Tor*) *putitora* (Ham.)	Hora, *Journ. Bombay Nat. Hist. Soc.* xli, pp. 277–284 (1939).	100 specimens: largest 1½ ft Naukuchya-tal, Bhim-tal Sat-tal and Kosi river.	All along the Himalayas.
9. *Crossochilus latius* (Ham.)	Mukerji, *Journ. Bombay Nat. Hist. Soc.* xxxvii, p. 50 (1934).	5 specimens: largest 19 cm. Kosi river (Khairna).	Peninsular India, along the Himalayas and Burma.
10. *Garra gotyla* (Gray) ...	Hora, *Rec. Ind. Mus.* xxii, p. 653 (1921).	3 specimens: 15 cm. each. Kosi river (Khairna).	All along the base of the Himalayas.
11. *Garra prashadi* Hora ...	Hora, *Rec. Ind. Mus.* xxxix, pp. 338–340 (1937).	4 specimens: largest 12 cm. Kosi river (Khairna).	Endemic in the Kumaon Hills.
12. *Labeo dero* (Ham.) ...	Hora, *Rec. Ind. Mus.* xxxviii, pp. 314–315 (1936).	8 specimens: largest 25 cm. Kosi river (Khairna).	All along the Himalayas, Sind Hills, Assam, Burma and Ceylon.
13. *Labeo dyocheilus* McClell.	Hora, *Rec. Ind. Mus.* xxxviii, pp. 320–321 (1936).	2 specimens: 18 and 31 cm. Kosi river (Khairna).	All along the Himalayas, and Sind Hills.
14. *Oreinus plagiostomus* (Heck.)	Misra, *J. Zool. Soc. India*, 1, pp. 39, 40 (1948).	80 specimens: largest 72 cm. Kosi river (Khairna) Naini-tal lake and Bhowali Nalla.	Afghanistan and Kashmir.
COBITIDAE			
15. *Botia almorhae* (Gray)...	Hora, *Rec. Ind. Mus.* xxiv, pp. 320–321 (1922).	3 specimens: largest 15·1 cm. Kosi river, Almorha.	Khasia and Almorha Hills.
16. **Lepidocephalus guntea* (Ham.).	Hora, *Rec. Ind. Mus.* xl, p. 177 (1938).	...	Throughout northern India.
17. *Nemachilus beavani* Gunth.	Hora, *Rec. Ind. Mus.* xxxix, p. 341 (1937).	47 specimens: 2 to 7.7 cm. Kosi and Gola rivers.	All along the eastern.

LIST OF FISHES KNOWN FROM THE KUMAON HIMALAYAS—(*Continued*)

Scientific Name and Systematic Positon of species	Reference	Number, size and locality of specimens in the recent collection	Distribution
Cobitidae—(*continued*)			
18. *Nemachilus botia* (Ham.)	Mukerji, *Journ. Bombay Nat. Hist. Soc.* xxxvii, p.39 (1934).	19 specimens : 3 to 8 cm. Kosi river and Ramgar nalla, (Ramgar).	All over northern India and Burma.
19. *Nemachilus rupicola* (McClell).	Day, *Fish. India*, p. 616, pl. clv, Fig. 9 (1878).	100 specimens : 3 to 8·4 cm. Bhowali nalla, Ramgar nalla, Naini-tal stream, Gola and Kosi rivers.	Simla to Naga Hills along the Himalayas.
Sisoridae			
20. **Glyptothorax pectinopterus* (McClell.)	Hora, *Rec. Ind. Mus.* xxv, pp. 18, 19 (1923).	...	Simla, Kangra and Dehra Dun Hills.
Amblycepidae			
21. **Amblyceps mangois* (Ham.)	Hora, *Rec. Ind. Mus.* xl, pp. 178, 179 (1938).	...	All along the Himalayas as far as Assam and Burma.
Ophicephalidae			
22. *Ophicephalus gachua* Ham.	Hora & Mukerji, *Rec. Ind. Mus.* xxxvii, p. 404 (1935).	11 specimens : largest 15 cm. Bhim-tal and Kosi river.	Throughout India, Burma and Andamans.
Mastacembilidae			
23. *Mastacemblus armatus* (Lacèp.)	Day, *Fish. India*, p. 340, pl. lxxiii, Fig. 2 (1878).	16 specimens : 6 to 14·6 cm. Kosi river (Almorha).	Throughout the plains and hill of India, Burma and Ceylon.

Specimens marked with an asterisk are not represented in the collection under report, but were recorded and described from the Kumaon Hills by Hora in the year 1937 (*Rec. Ind. Mus.* xxxix, pp. 338–48).

NOTES ON CERTAIN SPECIES

Garra gotyla (Gray).

1921. *Garra gotyla,* Hora, *Rec. Ind. Mus.* xxii, p. 553.

Three specimens of *Garra gotyla,* approximately 15 cms. each, were collected from the Kosi river. They were compared with the specimens in the collections of the Zoological Survey of India, and, as had already been pointed out by Hora, marked differences in the shape of the head and proboscis could be discernible between the Western and the Eastern Himalayan forms. Local variations also were noticed in this species. The specimens under report, for instance, differ considerably in the shape of the head and proboscis from those obtained from Kangra (Punjab) and Dehra-Dun. In the accompanying figure these differences are clearly shown.

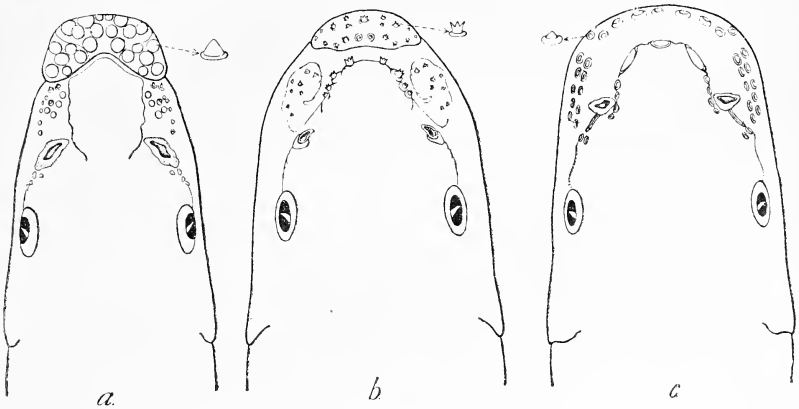

Fig. 1.—Outline sketches of head of 3 specimens of *Garra gotyla.* (*a*) from Dehra Dun, (*b*) from Kumaon, (*c*) from Kangra.

Garra prashadi Hora.

1937. *Garra prashadi,* Hora, *Rec. Ind. Mus.* xxxix, pp. 338-40.

There are four female specimens of *Garra prashadi,* in the collection under report. In all the important characteristics they agree with the typical specimens, but the head is not so bluntly pointed. The body is sub-cylindrical with slightly bulged out thoracic region. The dorsal profile rises very gently from the tip of the snout to the base of the dorsal fin. The dark spot behind the angle of the operculum, which is characteristic of *Garra prashadi,* is absent in these specimens.

Three small specimens of this species were first collected from Malva Tal, U.P., in May 1920 by Drs. B. Prashad and S. L. Hora. The second lot of about 77 specimens was collected from the rivers of Nandhaur and Kalaunia, U.P., in May-June 1936.

As this species has not been recorded from any other locality except the Kumaon Hills the exact limits of its distribution cannot be stated until an extensive survey of the Western Himalayan region is made.

Oreinus plagiostomus (Heck.)

1889. *Oreinus sinuatus,* Day, *F.B.I.* I. p. 248.
1889. *Oreinus plagiostomus,* Day, *F.B.I.* I. p. 250.
1949. *Oreinus plagiostomus,* Misra, *J. Zool. Soc. India,* I, pp. 39, 40.

Oreinus plagiostomus is represented by 80 specimens in the collection under report. They were collected mainly from the Kosi river, the Naini Tal lake and the Bhowali nalla. All the specimens, except one about 27 cms. in length, are immature individuals under 3 cms. in length. It would thus appear that the species breeds in April-May so far as this region is concerned.

According to Misra, *O. plagiostomus* and *O. sinuatus* are conspecific and they represent the male and the female respectively of one and the same species.

Nemachilus beavani Günther.

1937. *Nemachilus beavani,* Hora, *Rec. Ind. Mus.* xxxix, p. 341.

Nemachilus beavani is represented by 47 specimens in the collection and they range from 2 cms. to 7.7 cms. in total length. They were collected from the Kosi and Gola rivers and resemble the Eastern Himalayan examples in all important diagnostic features, except in one, that is, in the number of the vertical brown bands on the body. There are in these specimens from 10 to 12 vertical brown bands on the body which is a characteristic feature of *N. montana.* There is also a slight dorso-ventral depression of the body and head discernible in these specimens which again is a character of the *montana* species.

N. beavani of the Kumaon Hills may probably be an intermediate form between the *N. beavani* of the Eastern Himalayas, and the *N. montana* of the Simla Hills.

Nemachilus rupicola (McClell.)

1878. *Nemachilus rupicola,* Day, *Fish. India,* p. 616, pl. cliii, Fig. 9.

Nemachilus rupicola is represented by about 100 specimens in the collection ranging from 3 to 8.4 cms. in length. These specimens resemble closely the Western Himalayan race of the species in that the head of these forms is not so broad as the Darjeeling or the Assamese forms[1].

Nemachilus rupicola is abundant in the Bhowali, Ramgar and Naini-tal streams, and in the Gola and Kosi rivers.

Most of the specimens collected from the Bhowali naila were infested with certain parasitic cysts. Probably these may be cysts of trematode parasites. Faust[2] in the year 1927 described such cysts found in the body of fish collected from Kashmir and Seistan.

Botia almorhae Gray

1878. *Botia almorhae,* Day, *Fish. India,* p. 607, pl. cliv, Fig. 5.

There are three specimens collected from the type locality, Almorha, U.P. In general characters they agree with the description given by Day. *Botia almorhae* can be easily distinguished from other species of *Botia* by its long, bifid sub-orbital spine which extends to the hinder end of the orbit.

I give below a table of measurements of the three specimens for convenience of reference in future.

MEASUREMENTS IN MILLIMETRES

Length of the body including caudal ...	151·2	133·1	142·9
Length of the head ...	33·1	28·5	29
Height of the head ..	22·5	23	22
Breadth of the head ...	12·1	12	13·2
Depth of the body ...	31·1	27·2	27·5
Length of the snout ...	18	16·2	17
Diameter of the eye ...	4	3·8	3·9
Inter-orbital width ...	7·9	7·7	7·8
Height of the dorsal fin ...	23	19·2	23
Length of the pectoral fin ...	25·5	21	25
,, ,, ,, ventral ,, ...	21	18	19·5
,, ,, ,, anal ,, ...	25	20·5	23
,, ,, ,, caudal ,, ...	32·5	30	32
,, ,, ,, caudal peduncle ...	15·5	13	15·75

ACKNOWLEDGEMENTS

I wish to express here, on behalf of the survey party, our sincerest thanks to Mr. Smetacek of Naukuchya Tal for all the help that he rendered to us and made our stay there pleasant. I am also deeply indebted to Dr. S. L. Hora, Director of the Zoological Survey of India for all the valuable suggestions and guidance that he very kindly gave me in writing out this paper.

[1] Hora, S. L. and Mukerji, D. D., *Rec. Ind. Mus.* xxxvii, p. 400 (1935).
[2] Faust, E. C., *Rec. Ind. Mus.* xxix, p. 218 (1927).

THE STUDY OF INDIAN MOLLUSCS

BY

JAMES HORNELL, F.L.S., F.R.A.I. (Deceased)

PART II

(With 23 text figures)

(Continued from p. 334 of this volume)

The Volutes

In the Volutes (Volutidae) the shell is generally large and of beautiful colouring and shape. The animal is often larger than its shell can accommodate and as a consequence the operculum in these is wanting. The radula usually has but a single longitudinal row of teeth. The family has great interest for India, for besides the pretty and typical *Voluta lapponica* of our Indian seas, it includes the great Melon-Shell (*Melo indica*). In its youth this shell has a well-developed spire as in ordinary Volutes; with growth the body of the animal increases so fast and thus the mouth whorl becomes so inflated and overgrown that the spire is eventually hidden. Strong folds are present on the columella. The adult shell is almost globular with the mouth whorl so inflated that in New Guinea a closely related species is commonly used by fishermen as a bailer. Our Indian Melon-shell grows to a length of about eight inches. It is fairly numerous in five to six fathoms depth in Palk Bay, less numerous elsewhere. It appears therefore to prefer a bottom where a considerable amount of mud is present in the sand. The shell is pale reddish brown blotched with a darker shade. The animal—foot, mantle and head—is striped like a tiger with yellow and black. When crawling it presents a remarkable appearance, the shell all but lost to sight in the enwrapping folds of the gorgeous mantle and foot.

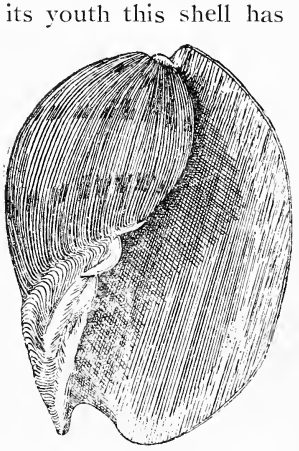

Fig. 29.—The Melon-shell, *Melo indica* Gmelin. ×$\frac{1}{3}$.

The eggs are deposited in an extraordinary egg-mass—one of the strangest produced in these seas. It stands nearly a foot high, a great honeycomb-like glassy cylinder made up of some hundreds of clustered capsules, each nearly an inch in length. In form and sculpture it resembles a tall cylindrical pineapple, the

capsules representing the bracts. A narrow cavity perforates the centre of the cylinder. The walls of the different capsules are tough, colourless and hyaline. As in the Chank a number of ova are deposited in each capsule, but with growth all disappear eventually but one, and this, when it frees itself by eating through the capsule wall, is nearly an inch in length. Long before they emerge, the young may be seen clearly through the transparent walls. The spire at this time is distinctly conical, and the whole shell extremely like that of the land-snails *Bulimus* and *Achatina*. A curious fact is that this giant egg-mass is not implanted in the sand as in the case of the chank; the parent carries the great mass with her until the young become free.

The Olives

The family of the Olives (Olividae) contains some of the commonest shells found on the east coast of India; on the west coast they are comparatively scarce. They are notable for their high polish and the beauty of their marbled colouring. Among themselves there is less difference in form than usual, the shape being roughly cylindrical, with a very short pyramidal spire and a long narrow mouth opening. The suture between the whorls is channelled and is in connection with the hinder end of the mouth aperture by way of a narrow slit in the lip through which a thread-like tactile process of the mantle passes, to lie when at rest in the channelled suture. The columella is overlaid with deposit and is striated obliquely. No operculum is present.

As in *Natica*, where the habit of life is similar, the shell is partly immersed in the swollen foot; the mantle lobes are also large and meet over the back thereby ensuring the maintenance of the high polish of the shell.

The Olives are very active; they burrow rapidly in wet sand in quest of the bivalves on which they feed and it is said that they may even be taken on a line baited with a fragment of flesh.

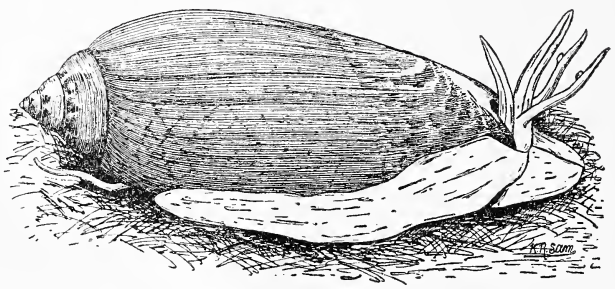

Fig. 30.—*Oliva gibbosa* Born., seen in crawling attitude. ×1½.

The common species is *Oliva gibbosa*. *O. ispidula* and *O. oliva*, together with the related *Ancilla cinnamomea*, are other less common forms. As a rule the species of *Ancilla* are of one uniform colour whereas those of *Oliva* are coloured variously with blotches,

spots and marblings. *O. nebulosa* is exceedingly common around Bombay.

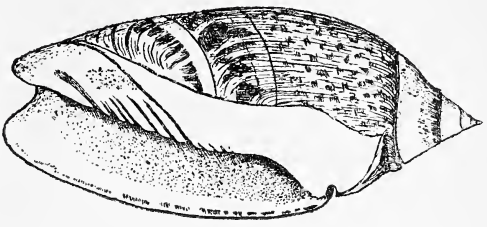

Fig. 31.—*Ancilla cinnamomea* Lam.

On the Coromandel coast Olives are extensively used as food by the Pattanavar or sea-fishermen caste. The chief collecting season is during spring tides during the fine weather period from February to April. Towards the end of the ebb Pattanavar women and lads search for them in shallow water by turning the sand over with their feet or, in the case of those in uncovered sand by marking the trails as the Olives travel about. The women boil their catch in fresh water, extract the flesh and then either use it in their curry or fry it in oil.

The Marginellidae are small shells akin in appearance and anatomy to the Olives; *Marginella angustata* is sometimes mistaken for a small Olive. A distinguishing character is the great thickening of the outer lip.

The Harp-shells

The last family of importance among the Rhachiglossa is that of the Harp-shells (Harpidae), a small group of very beautifully coloured shells, the polished surface adorned with prominent longitudinal ribs, suggesting the strings of a harp. The body whorl is greatly inflated (ventricose) as in *Tonna,* the spire short and the columella smooth and covered with a brilliant callus. The foot is enormous, with a semilunar fore-part separated by a transverse groove; no operculum.

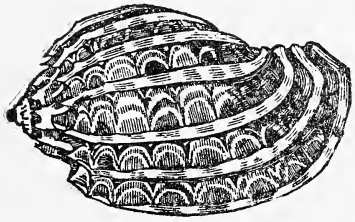

Fig. 32.—*Harpa ventricosa* Lam. ×½.

As is usual in highly polished shells the mantle is reflected over the back; this protects it from attrition, and damage. The only living specimens that I have found in India were in coral-reef pools in the Gulf of Mannar and in the Laccadive Islands. When irritated, *Harpa ventricosa*, our common local species, commits self-mutilation by severing and throwing off the hinder part of the great foot whenever alarmed, in frequently successful endeavour to escape.

Tribe 2.—**Toxoglossa**

The next three families, the Turridae, Terebridae and Conidae, possess a large 'poison gland' in the gullet, communicating by a duct with barbed teeth on the radula; they constitute the tribe of 'Poison-teeth' or *Toxoglossa.* As may be inferred from this, they are carnivorous in habit.

The Cones

The Cones (Conidae), as their name implies, are more or less conical in shape. The spire is usually very short and may even be telescoped so greatly as to give the apical end a truncated appearance. The aperture is long and narrow, the outer lip thin; the operculum is small, narrow and claw-shaped. Internally the partitions are partly absorbed.

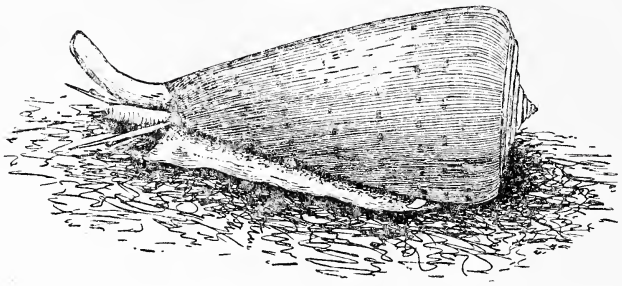

Fig. 33.—Life appearance of *Conus monile* Brug. ×1.

The family is very numerous in species, mainly tropical in habitat; it includes many most brilliantly coloured shells, some so rare and beautiful that collectors have paid as much as Rs. 750 for a single shell. Some species are dangerous to handle on account of the poisonous nature of their bite; none of our fishermen appear to fear them; the South Sea Islanders on the contrary have a most lively dread of them, and allege that their bite is liable to prove fatal!

Our common species chiefly haunt coral reefs. They include *Conus ebraeus* (the marking resembling Hebrew letters). *C. figulinus, C. litteratus, C. geographus,* and *C. ceylanensis,* the last with a characteristic white band in the middle of the mouth whorl. *C. textile* is a magnificent shell, large and beautifully polished.

The Slit-lips

The Slit-lips (Turridae) are even more numerous in species than the Cones and, unlike them, are world-wide in distribution. They are nearly all very small in size; in shape fusiform with a tapered spire and an elongated body-whorl ending in a long canal. A deep slit or notch in the thin lip close to the suture is their characteristic feature. Our common species are *Turris indica* and *T. acuta.*

The Augers

Lastly we have the Auger-shells (Terebridae), very long tapered shells of many whorls, resembling in general form the Turret-shells (*Turritella*) but stouter and, instead of the shells being sculptured into spiral ridges, they are generally smooth surfaced or noduled and brightly ornamented with coloured spots—commonly with orange on a white ground. *Terebra duplicata* is not uncommon

in moderate depths on sandy bottom around the mainland coasts. In the Laccadives they seem much more numerous; from one short visit examples of five species were brought back including *T. maculata*, and *T. crenulata*.

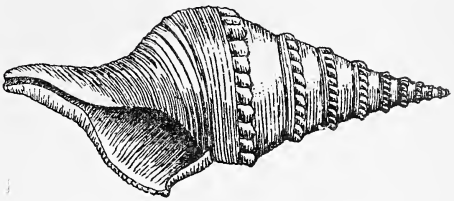

Fig. 34.—*Surcula javana* L.

Sub-class II.—*EUTHYNEURA*

The Gastropods belonging to this group have the visceral nerve straight and not twisted as in the Streptoneura with which we have just dealt. Another characteristic is the excessive development of the sides of the foot into lateral folds or epipoda. These tend to envelop the shell and in degree as this is more complete and permanent, so the spiral form of the shell is reduced and its substance lessened in thickness, till it eventually becomes lost. In the most specialized in this direction, the torsion or twisting of the body tends to disappear and the animals gradually acquire a *secondary* external symmetry. The group is divided primarily into the orders Opisthobranchia and Pulmonata, the former marine, with breathing arrangements suitable for life in water; the latter without gills and normally air-breathers.

Order I.—Opisthobranchia

This order includes the Bubble-shells (Bullidae), the Sea-Hares (Aplysiidae), the Umbrella-shells (Umbraculidae), one section of the Pteropods and the large and interesting shell-less group of the Nudibranchs.

The Bubble-shells

The Bubble-shells (Bullidae) are abundant on sandy bottom in shallow water. The swollen oval shells of *Bulla ampulla*, seemingly all 'mouth', mottled with pale transparent brownish-red, are often thrown ashore on our sandy beaches. In life none of the shell is seen, the fleshy lobes of the foot being reflected over the shell both at the sides and behind. In front the foot, as in many other burrowing mollucs, *Natica* and *Oliva* for example, forms a stout head-shield—the equivalent in its economy of a ploughshare.

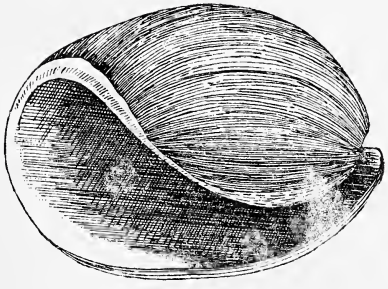

Fig. 35.—Bubble-shells (*Bulla ampulla* L.).

A closely allied species is the little *Cylichna cylindracea*, belonging to the family Scaphandridae, often found in the neighbourhood of Bombay. Its shell is cylindrical with a long and narrow opening; it is not unlike a young Olive. The Scaphanders live upon other shellfish but instead of boring a hole in the victim's shell, in

order to suck out contents, they swallow their prey whole, grinding it up, shell and all, within a powerful gizzard.

An extremely beautiful animal is the Striped Bubble-shell (*Hydatina velum*), belonging to the Aplustridae. (Fig. 36.)

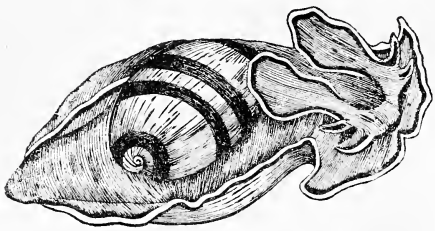

Fig. 36.—Life appearance of *Hydatina velum* Gmelin. ×1.

The shell has the form of *Bulla* but is thin and fragile and ornamented with broad spiral black bands on a pale ground. The foot is very broad; the head disc extremely large. The true tentacles (there are four labial ones) are wide and ear-shaped and of enormous comparative size. The colouring of the foot and tentacles partakes of the colour scheme of the shell; it is a wonderful sight to see this creature when crawling in a pool, the shell partly uncovered, the great head with its elephant-ear tentacles stretched forwards and the wide side-folds partly reflected, undulating gracefully over roughnesses of the ground.

The Philines

In the Philinidae the form of the body is fully specialized for burrowing. The shell has become thin and small, the spire almost lost and the aperture wide and ear-shaped; it is embedded entirely and there is therefore no longer a clumsy projecting mass on the back as in *Natica* and *Oliva* and *Bulla* to hinder easy progress through sand. The lobes of the body are fleshy and smooth, without projections, the whole an animated ploughshare, perfect for the purpose of burrowing rapidly. Like *Bulla* and *Cylichna* it has a powerful gizzard armed with a crushing apparatus composed of three shelly plates. The common Indian species of *Philine* is shapeless in appearance, a mere mass of four fleshy lobes. It is not uncommon in soft wet sand.

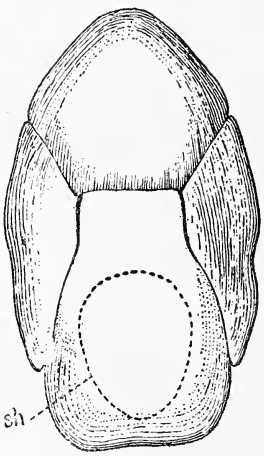

Fig. 37.—Living appearance of *Philine*, dorsal view; the dotted line outlines the position of the shell embedded in the mantle.

Very different is the beautiful little *Lobiger* of the family Oxynoidae. The Indian species, *Lobiger nevilli*, is often seen in great abundance in quiet, sheltered bays wherever sea-grass prairies are to be found. At first sight the observer is inclined to identify it as one of the naked forms known as Nudibranchs until the rounded shell is seen protruding from the back. The body is slender and slug-like, tapering off behind into a long, narrow pointed tail. The head bears two short, flattened tentacles, while on each side of the body proper, rise upwards two pairs of great leaf-like lobes or fins, whereof the anterior pair is slightly the smaller. Each of these four fins is a

thin, wide lobe with frilled edges, attached to the body by a muscular stalk. When alarmed or disturbed the animal seeks to escape

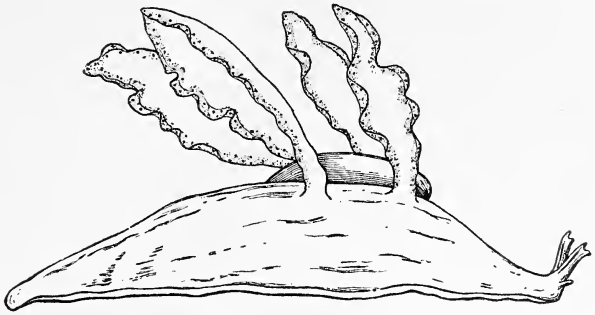

Fig. 38.—*Lobiger nevilli* Pilsbry, showing the oval shell lying between the two pairs of fins'. ×2.

by throwing off its fins; when cast off, these exhibit slight movements for some time after. With the help of its mobile tail and of these paired fins *Lobiger* is enabled to swim with ease. The oval shell, slightly convoluted, is transparent and very delicate; its convex surface is freely exposed on the middle of the back, between the fins; there is here no need as in *Bulla* and *Philine* to protect it from sand attrition, for *Lobiger* pursues a free life in the sea, never attempting to burrow. The body-colour of our only Indian species is normally a brilliant green, harmonizing with the colour of the sea-grass of the shallows where it abounds. Sometimes minute dark specks are scattered through the green. The fins are of a similar green colour but each is bordered with a band of coral red speckled with black dots. *Lobiger* appears to posses some power of colour adaptation, for when placed in a white vessel it becomes yellow, the lovely scarlet border to the fins disappearing in the effort to assimilate its colouring to the environment.

Sea-Butterflies

Here are placed by several eminent systematists the shell-bearing Pteropods, 'Butterflies of the Sea' as they are often termed. They spend their whole life in the open sea and though the number of their species is small, individually they often occur in such vast swarms as to discolour the water for miles; they form the principal food of the Baleen Whales. Their shells are either tubular (*Creseis*) or broad and pocket-shaped (*Cavolina*); those of the former are often abundant in the plankton of our waters but so small, pellucid and needle-like as make them difficult to be recognized except when examining under a microscope the catch of minute floating oceanic life made by a tow-net. The shell of *Cavolina* on the contrary is horny and brown and sufficiently stout to be easily identified when thrown ashore after storms,usually in company with *Ianthina* and violet-coloured siphonophore jellyfishes.

The Pteropods differ from other molluscs in the transformation of the foot into a pair of great wing-like swimming fins, arranged

one on either side of the mouth, the head as a distinct organ having virtually disappeared.

The Sea-Hares

The Sea-Hares (Aplysiidae), so named from a fancied resemblance to a crouching hare, are heavily built grotesque creatures, lumpy and soft to the touch; they possess a thin and much reduced transparent shell, brown and ear-shaped, all but covered by the mantle and further protected by two fleshy side lobes of the foot. The stumpy head is armed with two pairs of tentacles, the hinder the larger. The middle region of the body rises high with a humpy back; behind, the broad flat foot passes into a short but distinct tail. In colour *Aplysia* is mottled and spotted a dirty purplish brown with spots and blotches of greyish tint scattered throughout.

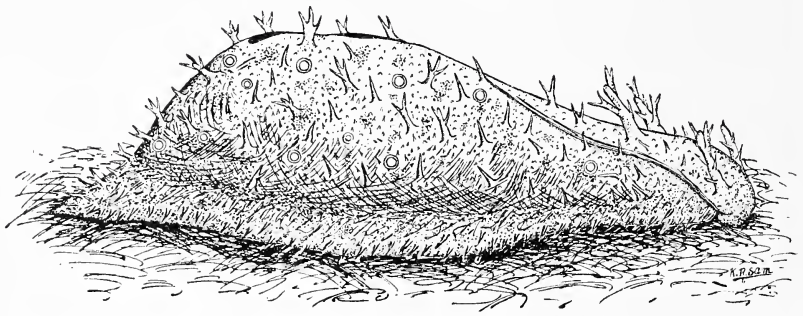

Fig. 39.—Life appearance of the Plumed Sea-hare (*Notarchus*), from Ennur backwater, Madras.

Species of *Aplysia* are common in most parts of the world; the common Indian one is almost indistinguishable from the British, and is equally abundant in weedy shallows in bays and the seaward ends of backwaters. These molluscs vary greatly in abundance from year to year; sometimes they appear along the margin of the sea in multitudes; in other years scarcely one is to be found at the same season. When handled they discharge a large quantity of purple fluid from glands under the mantle. This secretion is harmless but is undoubtedly protective for it discolours the water for a considerable distance around, alarming to any fish with predatory intent. The odour is also unpleasant and to some persons is distinctly nauseous.

Aplysia deposits its ova in long, greatly tangled cords, of considerable total bulk, the colour brownish pink. In India the spawning season is February and March. At this time the animals are notably gregarious. Another notable Indian genus is *Dolabella*.

Yet another genus closely related in form, size and colour is *Notarchus*, marked off sharply from *Aplysia* by the presence of long filaments, the larger dendritic, scattered thickly over the whole upper surface of the body. Whether this is in any way protective I do not know. The lateral flaps in this genus are united behind and not open as in *Aplysia*, leaving only a small aperture on the summit

of the back. No shell is present, a stage further—the final one—in the process of the elimination of what had become a useless structure. Large and beautiful eye-like spots are scattered over the body, the centre peacock green, ringed round with pale orange; each is at least three millimetres in diameter.

The gelatinous egg-cords, filled with opaque dirty reddish ova are similar to those of *Aplysia*. The spawning time is the same and so is its habitat—wherever weedy shallows are to be found. It is very common in some years in the month of March.

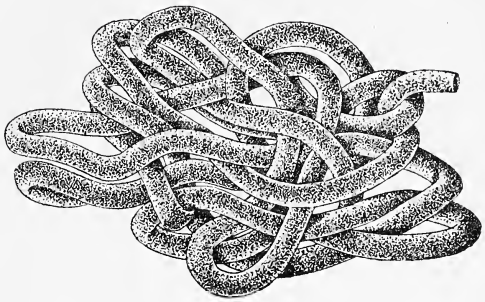

Fig. 40.—Egg cord of *Notarchus*. ×1.

The Umbrella-shells

The Umbrella-shell (Umbraculidae) is another clumsy creature of large size not uncommon in moderate depths on the east coast (probably just as common on the west coast wherever the habitat is suitable). It is easily recognized by the circular flat shell that partially covers the back of its ugly, tuberculated body, solid and muscular. The shell is quite uncovered and hides the large plumed gill lying beneath the mantle on the right side. The head is small and, like that of the tortoise, is retractile into a deep notch in the front of the enormously massive foot. *Umbraculum indicum*, with a shell often five inches in diameter, is our common Indian species.

Representative of the Pleurobranchidae is the dull, unsightly *Pleurobranchus*, coarsely slug-like in shape, greenish drab in colour and rough surfaced. It is often found in dirty muddy pools between tide-marks at Rameswaram and on the south shore of the Gulf of Kutch. The mantle extends over the back and entirely conceals the shell which is an oblong flexible horny plate, slightly convex. The head bears two pairs of short fleshy tentacles and, like Umbraculum, the foot gives off no lobes at the side as does Aplysia. As if its appearance were not sufficiently repulsive, spicules are developed within the mantle.

Naked-gilled Gastropods

Wherever wide expanses of bare sand prevail on the Indian littoral and in the adjacent shallows, the important sub-order of the Naked-gilled Gastropods—the Nudibranchia—are not well represented; their especial habitat is among weed-clad rocks washed by a strong tide-run. Rocky ground from Sind to Bombay and the Gulf of Mannar are their favoured haunts; here are to be found many and beautiful forms. Unfortunately they are the most difficult of all animals to preserve in their natural shape and colour, shrinking to uncouth lumps when killed unless infinite care be taken to

narcotize them; even so they have to be brought very gradually into the preservative fluid. To study them satisfactorily they must be examined in the living condition for at present we know almost nothing of the life appearance of many species and still less of their habits.

They are slug-like animals without shell of any sort. Internal gills are absent, their place being taken by outgrowths from the back, protean in the variety of their form and often exceedingly elegant and brightly coloured. In some, these form rosettes, in others richly arborescent filaments, or club-shaped knobs or even simple folds not unlike those of *Lobiger*.

In certain instances the vivid colours are assumed as warning colouration—possible enemies are told to beware of the calcareous spicules present in the skin of certain species (*Chromodoris*) or of the stinging cells which in others (*Aeolis*) are developed in the dorsal processes. In another group the colouring is protective and mimetic, harmonizing with that of the sea-weeds and animals amid which they live.

Retractile-gilled Nudibranchs

The commonest of Indian nudibranchs belong to the family *Doridiidae*, distinguished by the presence of a rough, tuberculated dorsal shield, stiffened by the multitude of spicules embedded in it, and by the possession of external gills, usually pinnate or plumose, retractile within the orifice of the vent situated near the hinder end of the body. These retractile gills characterize the group of nudibranchs termed Anthobranchia. The most common Indian genus is *Glossodoris*. *G. petechialis* is abundant in the Gulf of Kutch, and the neighbourhood of Karachi, together with the related *C. semperi*. Another common Indian nudibranch is *Plocamopherus ceylonicus* belonging to the family Polyceridae, distinguished from the Doridiidae by the gills or 'branchial tufts' being non-retractile and situated about the middle of the back.

Finger-gilled Nudibranchs

Interesting as these are, they cannot vie in beauty with the species belonging to the group of the Polybranchia where the gill filaments, resplendent in vivid hues, sprout from the sides of the body in all manner of variety. In some, as in the Aeolid *Pteraeolidia semperi,* the gill processes or *cerata* form a waving forest of long finger-like processes, brightly coloured.

An extremely peculiar and interesting creature is the soft, semi-gelatinous *Melibe rangi,* not uncommon on the pearl-banks of the Gulf of Mannar and under like conditions in the Gulf of Kutch. From the back of its slug-like body rise six or eight pairs of large semi-transparent lobes mottled olive green and brown; unlike the cerata of the Aeolids which are not voluntarily thrown off, those of *Melibe* drop off at a touch (caducous); when taken in a net they separate at once from the body and then become very puzzling to those who find them if they have no previous knowledge of the animal. Each lobe is somewhat flattened laterally and of crested wedge-shape. Over the whole surface are scattered irregularly

numerous tufted tubercles. Under the microscope each is resolved into a group of digitate papillae having colourless transparent walls containing threads of brown cell-rows. These threads belong to a lowly species of alga living in virtual partnership with its molluscan host—a most interesting instance of symbiosis.

Fold-gilled Nudibranchs

The last group of the Nudibranchs is a small one, that of the Pellibranchia; it is distinguished by the absence of external gills, their place being taken by a broad and sensitive fold on each side of the body. Through these ramify a system of blood vessels, thereby allowing respiration to be effected directly through the thin walls of the folds. These, beautifully margined by a border of contrasting colour, function also as swimming fins. The Indian representative of the group is *Elysia grandifolia,* of a brilliant green ground colour with the green fins bordered with a band of yellow, itself margined by a thin line of black.

Order II.—Pulmonata

With the exception of certain fresh-water forms which have re-acquired gill-like breathing organs, the Pulmonata are air-breathers in which the walls of the mantle cavity are traversed by a net-work of fine blood vessels, constituting a true lung. Their most familiar representatives are the land-snails and slugs, the former with a typical spiral shell; the latter, so far as India is concerned, have none externally but most of them possess a small internal plate or a few calcareous particles hidden beneath the skin of the back—vestiges of the ancestral shell.

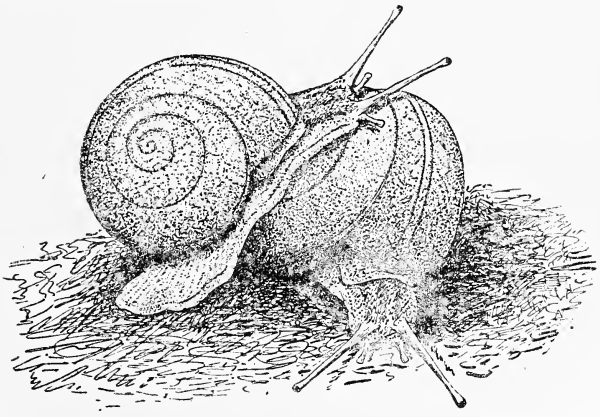

Fig. 41.—Two individuals of the Common Madras Snail (*Xestina bistrialis* Beck.).

In peninsular India two distinct land-snail areas exist, the one, the dry zone extending over the eastern and south-eastern regions—the other, the wet zone, comprising the ghaut region of the west—the Bombay Presidency, Malabar, Cochin and Travancore, together with the Anamalai, Nilgiri and Palni Hills. This wet zone has

intimate relationship with Ceylon: it is indeed classed as part of the Sinhalese Zoological Province by faunistic writers.

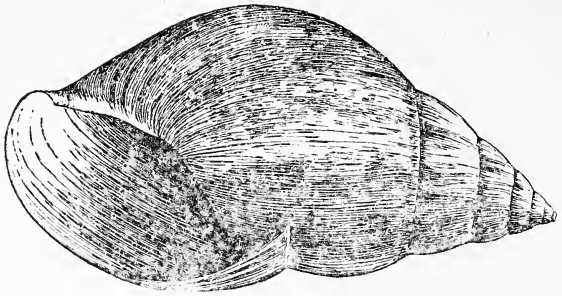

Fig. 42.—Shell of *Achatina fulica* Ferussac.

There is, however, much overlapping of these two regions and much intermingling of species. For example we are told that the Sinhalese province is characterized by the dominance and abundance of the genus *Helix,* while *Ariophanta*—which differs from *Helix* in having a mucus pore at the end of the tail—is considered to take its place very largely in the Indian dry zone. As a matter of fact Ariophantas are particularly abundant on the wet zone Anamalai and Nilgiri Hills and include the Imperial Snail, *Ariophanta basileus,* a magnificent species growing to 2½ inches in diameter, characteristic of the Cochin teak forests where it is occasionally eaten by the semi-wild tribes who live on forest produce; it is also found in the Anamalai and Nelliampathi Hills. Two smaller species are, however, abundant and characteristic of the dry zone area; one is the single-banded *Xestina ligulata,* the other the two-banded *Ariophanta biserialis.* These are common in Madras gardens.

Conversely, a wet-zone Helix (*H. vittata*), with a white shell coloured red-brown within the mouth cavity, is to be seen everywhere in the Tinnevelly and Ramnad Districts on babul and other dry-zone bushes. They are reputed to have a bitter taste and this probably accounts for their immunity from attack by birds; their white shells make them extremely conspicuous on the dark leafless thorns during the hot weather when bird food is scarce. During this period our Indian land snails lie dormant, closing the aperture of the shell by mucous secretion that dries hard and prevents evaporation from within. As this resting stage occurs in hot countries during summer it is termed aestivation, the converse of the winter rest or hibernation of animals in temperate and cold regions.

Into Ceylon a huge snail, *Achatina fulica,* whose home is Africa and Madagascar, was introduced about the beginning of this century; it is now a recognized pest causing considerable loss owing to its depredations in vegetable gardens in the low-country region. The shell is ovoid with a well-developed conical spire and it grows to a length of five inches. Its eggs are bright yellow and about one-tenth of an inch in diameter. Apart from Bengal where it has had a footing for over 80 years and where it is common in Calcutta gardens, it has failed to spread elsewhere in India. (Fig. 42).

Stylommatophora

The shell-bearing pulmonates mentioned above belong to the section Stylommatophora, characterized by bearing eyes on the summits of the posterior of two pairs of invaginable tentacles. In the same section are located the true slugs belonging to the family *Limacidae*. In these naked slugs the body is elongated, narrowing behind into a pointed tail. The mantle is restricted to a shield-like area placed over the fore part of the body; beneath it is a small calcareous plate representing the shell. A large respiratory orifice opens on the right side rather far back. Several species of *Limax* are common in India, the majority limited to the wet-zone.

A remarkable genus of aberrant Pulmonates in that of the slug-like *Onchidium*, which frequents the sea-coast wherever there are brackish marshes and mangrove swamps. Unlike *Limax* the mantle covers the whole of the back and is covered with tubercles; a remarkable feature is that, in addition to the usual pair of tentacular eyes, a number of other eyes are developed upon certain of the tubercles on the back. They possess a lens, retinal nerve-end cells, retinal pigment and an optic nerve as do the tentacular eyes but, strangely enough the relationship of the nerve filaments to the retinal elements of the dorsal eyes is planned on the same fashion as in the vertebrate eye and the pallial eyes of *Spondylus* and *Pecten*, and not on the ordinary molluscan cephalic eye-plan as best exemplified in the eyes of Cephalopods.

I have found *Onchidium* on the north shore of Kathiawar and as it occurred in company with the little Mud-skipper fish *Periophthalmus*, Semper's observation that the fish comes ashore hopping and skipping in pursuit of *Onchidium* is doubtless correct. In such case the presence of dorsal eyes are of special value to the mollusc in enabling the approach of the enemy to be sensed in time to permit of an attempt to escape.

Basommatophora

In the second main division of the Pulmonates, the *Basommatophora*, the cephalic eyes are placed at the base of the single pair of tentacles present, and these tentacles while contractile are not invaginable. The majority of the genera are inhabitants of fresh-water, but the Ellobiidae or Ear-shells are an exception. One Indian species is exceedingly common among the roots of mangroves in tidal backwaters, and others in moist spots near the sea. The shells are oblong or oval with a well-developed spire; the outer and inner lips are thickened and expanded; in one common species both are conspicuously toothed; in others only the inner lip is so armed. Some have a superficial likeness to the little Nassariid *Arcularia*; the form of the mouth is, however, quite different.

Of fresh-water snails belonging to this division, *Lymnaea* and *Planorbis* are typical, the one elegantly spiral, the other discoidal, coiled in a flat sinistral manner. The shell of *Lymnaea* is thin, horny and fragile, with a large body-whorl and usually a sharply elongate spire; the colour brown. In *Planorbis*, generally a much smaller snail and nearly black, the shell is stouter. It is specially

remarkable because a lobe of the mantle just outside the pulmonary cavity has been metamorphosed into a functional gill; this genus therefore, derived from an air-breathing land pulmonate, which in origin evolved from a water-breathing gilled marine gastropod, has returned to a wholly aquatic life and has re-adapted its breathing apparatus a second time. It is noteworthy that the original form of the branchiae has not reappeared, a wholly different part of the body being specialized anew for the purpose, a fact which Pelseneer remarks 'illustrates the irreversibility of evolution'.

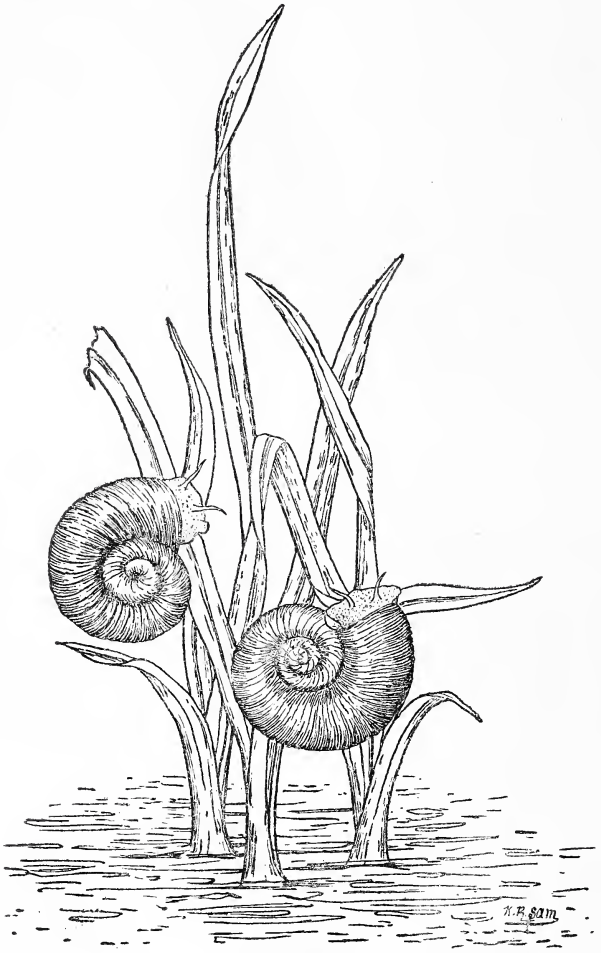

Fig. 43.—Pond-snails (*Indoplanorbis exustus* Deshayes) crawling on water weeds.

Both *Lymnaea* and *Planorbis* have the habit of crawling upside down beneath the surface film of the pond wherein they live, the foot gliding along as if it were moving along a sheet of glass; the well-known phenomenon of the surface tension of fluids is the explanation of this miracle. The spawn of both genera is deposited in colourless gelatinous masses on stones and water

weeds. In hot weather when tanks and streams dry up, these water-snails aestivate in the mud after the fashion of *Pila* and *Viviparus*.

Class III.—SCAPHOPODA

Standing apart from all other Gastropods is the little group of the Scaphopods, in many ways so specialized as to appear degenerate for there are neither eyes, nor true tentacles nor any distinct head present; neither is there any gill nor any true 'heart'.

The only well-known species are the Tusk-shells (Dentaliidae). In these the edges of the mantle lobes unite to form a complete tube, and as a consequence the shell is tubular. At one end, the posterior, it is narrow, widening gradually to the other end through which protrudes the broad, muscular burrowing foot and a number of long filaments. These last, the *tentacula,* are believed to be employed for the capture and dragging to the mouth of the foraminifera and diatoms on which these animals feed.

The Tusk-shells belonging to the genus *Dentalium* are often very common in sandy ground in depths of a few fathoms around our coasts; their empty shells are often cast up ashore. The most abundant species in Indian waters, *Dentalium octogonum,* has a very pretty curved shell, snowy white, with eight grooves running down the entire length, giving an octagonal outline in transverse section. It grows to a length of 1½ inch. Another species, very rare, grows to a length exceeding three inches and is stout in proportion. This species (*D. formosum*) which I have seen on only a few occasions, has a shell mottled with shades of dark red, a very handsome object. All live buried obliquely in the sand, pointed end upwards. In this there is a small perforation and through this passes the water required for breathing.

It is interesting to note that the Scaphopods were for long mistaken by naturalists for tube-forming annelids so close is the superficial resemblance both of their tubes and of their head filaments to those of certain of these marine worms.

Class IV.—LAMELLIBRANCHA or PELECYPODA

The most conspicuous characteristic of this class is that the shell is in two parts or *valves,* hence the convenient semi-popular term of Bivalves often applied to them. The mantle consists of two lobes, a right and a left, corresponding to the two valves and enveloping the body between them. A head is virtually absent and no radula or teeth are present, whereas the foot, frequently developed into a narrow, axe-shaped organ, is often of considerable size and of great mobility and strength in sand-burrowing species. The breathing organs are developed into plate-shaped gills, varying greatly in structure; these differences are now made use of in the classification of these molluscs. The majority of species pass their lives in burrows in sand or mud; others anchor themselves by a cable of fine threads, the byssus; in some, one valve is cemented to a stone or a rock; a few bore into wood and stone and others

are so exceptionally active that they swim through the water by alternately flapping their valves open and shut.

Their food consists of minute organisms, animal and vegetable, swept within the cavity enclosed by the mantle lobes by the rhythmic lashing of cilia lining the interior. These particles are then intercepted by the filter-like structure of the gills and wafted to the mouth by other sets of cilia.

Before describing some of the common Indian bivalves, an explanation of certain technical terms is necessary for the ready understanding of the subject. If an ordinary bivalve such as a cockle or an oyster be taken in the hand and held in such a position that the hinge is uppermost and the mouth side directed forwards, we are holding the shell with its *dorsal* side uppermost, its *ventral* side down, the *anterior* end turned forwards and the *posterior* end toward the hand holding the shell; in this position the valve on the right is the right valve, the other the left one. The elastic pad joining the two valves at the hinge is the *ligament* and the fine skin often present on the surface of the shell is the *periostracum*. Usually the hinge is formed by small interlocking projections, the hinge teeth. The valves are kept shut by the contraction of powerful *adductor muscles*, usually two in number, one towards each end of the shell. These pass across from one valve to the other; when they relax slightly, the lips of the shell open, the normal condition; after death these muscles relax completely and the shell gapes widely owing to the elasticity of the ligament which acts precisely as though a small pad of indiarubber were inserted under compression in the hinge.

In burrowing species where the shells lie mouth downward in the sand the two mantle folds join posteriorly at three points to form two apertures—the inhalant and the exhalant. In bivalves that bury themselves deeply the margins of these apertures are extended into a pair of long tubes, the *siphons*. Through the inhalant or branchial siphon, water, laden with microscopic food, is drawn within the mantle cavity, where it filters through the gills and then passes out through the exhalant siphon.

The two chief orders of the Lamellibranchs are the Filibranchia and the Eulamellibranchia. In the former the thread-like gill filaments lie parallel to one another and are bent upon themselves (reflected upwards) at about half their length. In the latter the filaments instead of being free are united at regular intervals by cross bars containing blood vessels and thus form a more efficient breathing and food-collecting apparatus—a very perfect form of filter.

Order I.—Filibranchia

False and Window-pane Oysters

The first family for consideration is the Anomiidae. In India both its notable genera *Anomia* and *Placenta* are represented. *Anomia*, often called the False Oyster is a small shell usually about 1½ inch in diameter, frequently adherent to edible oysters wherever found. *A. achaeus* is the common species. It has a beautifully

pearly shell, often golden in tint, very like a young edible oyster in shape, but thin, translucent and fragile. It rests with its right or flat valve downwards; the left valve is convex. Through a hole in the lower valve a shelly plug passes; by this it attaches itself to fixed objects. This plug is a modification of the byssus which in most other bivalves consists of numerous elastic horny filaments.

Placenta placenta, the Window-pane Oyster, grows to a much greater size, often five and even six inches in diameter. It is orbicular in outline when adult, very much compressed and remarkable for a ∧-shaped tooth to which the ligament is attached. It forms no byssus, lying more or less prone on the muddy bottom of estuarine creeks and landlocked bays wherever these occur on Indian coasts. Notable localities are Karachi Harbour, the Indus creeks, the Gulf of Kutch, Bombay Harbour, bays and creeks in Portuguese India, Tuticorin Harbour and the neighbourhood of Chittagong.

The foot is long and trumpet-shaped; it is employed mainly for freeing the interior from mud that finds its way in and would otherwise choke up the fine network of the gills. The shell is peculiarly soft; both in appearance and substance it resembles mica, particularly when immature. Small shells are usually colourless, clear and translucent; the Chinese ages ago noted this, and with their usual ingenuity put it to the useful purpose of glazing windows and verandah roofs. For this purpose young shells are trimmed into squares about 2½ in. across and then secured between narrow battens of wood arranged vertically. The Portuguese borrowed the idea and introduced it into their Indian possessions in the 16th century. To-day the windows of the older houses in Goa and Diu are still glazed in this manner; the Governor's old palace at Marmugoa has fine examples of such windows.

In some localities—not in all—*Placenta* produces a large abundance of seed pearls, too soft for jewellery and often misshapen, but still valuable for use in indigenous medicine in India and for the production of an expensive lime as an ingredient of the *pan supari* used by the fastidious wealthy. Four such places in the Indian region are Chittagong, Tamblegam Bay in Ceylon, the Gulf of Kutch and the creeks of the Indus. In all these localities *Placenta* forms beds of great extent, numbering shells by the million; the revenue derived from these fisheries is sometimes of considerable importance. Usually these fisheries belong to the State, a royal prerogative of ancient standing.

The anatomy and habits of *Placenta* are dealt with in great detail by the present writer in his *Report on the Anatomy of Placuna placenta,* etc.[1]

The Ark-shells

The Ark-shells (Arcidae) constitute a large family including many Indian species, varying widely in appearance and habits.

[1] Hornell, J., in vol. i. of *The Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar,* London, 1909, pp. 43-97, with 5 plates and 2 text-figures. 4to.

All agree, however, in having the hinge armed with a large number of tiny plate-shaped teeth disposed in a straight row on each side of the hinge. The shells are often angular, radially ribbed and covered with periostracum. The mantle is open and no siphons are present. The best known Indian species are *Arca granosa*, *Trisidos tortuosa*, *Barbatia fusca*, *Glycymeris taylori* and some small species that live in crevices in corals.

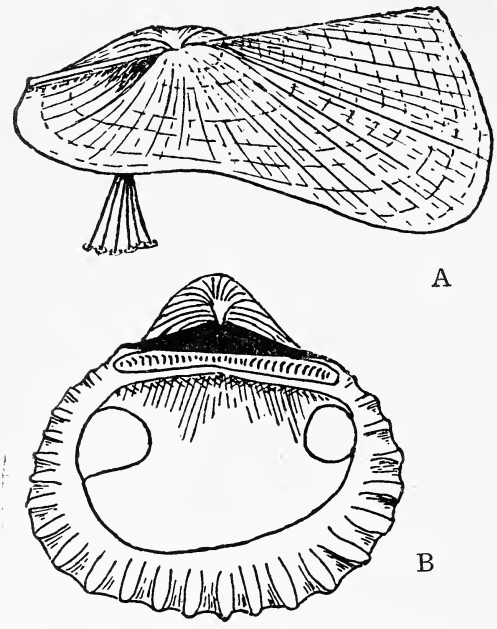

Fig. 44.—A, *Trisidos tortuosa* and its byssus; B, Inner view of a valve of *Arca granosa* L. Both × 1.

The **Ribbed Ark-shell** (*A. granosa*) is a fine shell found widely distributed in backwaters and estuaries. In appearance it looks like a very rugose cockle; the flesh is distinctively coloured red, due to the blood being of this hue, an exceptional condition among molluscs where the blood is generally colourless or tinted pale bluish-green. The flesh is tough but because of its red colour some shore people on the Madras coast have the idea that it has specially nutritious and strengthening qualities; on this account it is often given to women in pregnancy. It is also much valued by the poorer people of coast villages on the Bombay coast who collect great quantities from sandy bays. In size it seldom exceeds 53 mm. in length by a thickness of 43 mm. It is noteworthy that this species is the subject of very profitable cultivation in Japan, where the spat at a size of about 3 mm. are collected from the natural settlement grounds in immense numbers and relaid on special culture areas. As they grow larger, from time to time they are redistributed in order to avoid the danger of overcrowding and consequent food shortage. This species burrows free in sand.

In the open sea the estuarine *A. granosa* is replaced by the Hairy Ark-shell (*Barbatia fusca*) and the Twisted Ark-shell (*Trisidos tortuosa*). The former is ribbed and cockle-shaped, covered with dense black periostracum thickly beset with short bristle-like hairs. The second species was well named *Parallelopipedum tortum* by some authors, for whilst the opposite sides are roughly parallel, none of the angles are right angles and the shell appears as if it had been twisted out of shape when in a plastic condition (Fig. 44, A). The habitat of both the species named is between the $4\frac{1}{2}$ and 6 fathom lines on a bottom of dirty muddy sand.

Neither forms continuous beds, occurring scattered singly over a large area.

A small, elongated and very typical Ark-shell not unlike *T. tortuosa* is found in crannies among massive corals and sometimes in empty burrows made by boring molluscs, especially of the Date-shell (*Lithophaga*). The foot is large and secretes a short and massive horny byssus made up of thin plates of a characteristic bronze green colour.

Closely allied but very different in appearance is the equivalve *Glycymeris*, a common shell in depths of a few fathoms wherever there is sandy bottom. In shape it is orbicular, somewhat compressed and smooth, with central umbones. The hinge is curved and so the line of the comb-like hinge-teeth is somewhat arched instead of being straight as in *Arca*. *Glycymeris* lives free and unattached and so powerful is its crescent-shaped foot that some species are able to leap to a height of several feet when disturbed. *G. taylori* is a common Indian species.

Mussels

The well-known Mussels (Mytilidae) form another large family. The three common genera of these seas are *Mytilus*, *Modiolus* and

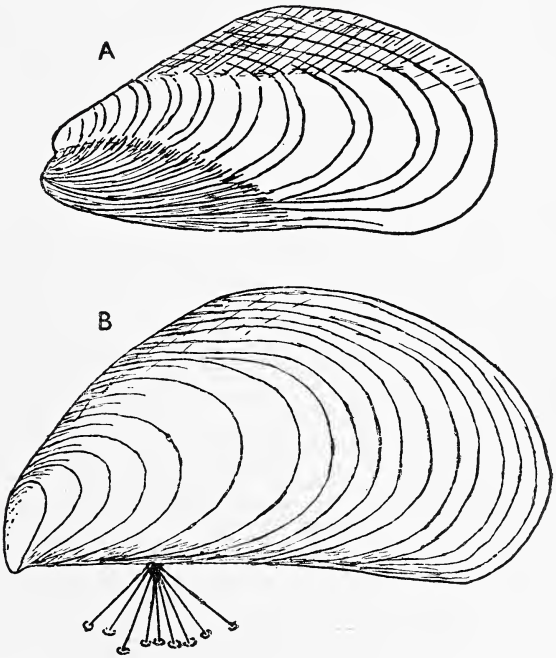

Fig. 45.—A, a typical *Modiolus*; B, a typical *Mytilus* (*M. viridis* L.). ×¾.

Lithophaga. All have elongated shells with the hinge close to the anterior end, and unprovided with teeth. In *Mytilus* the umbones are right at the anterior end; in *Modiolus* they are some distance away. Both live attracted by byssal cables; *Lithophaga* on the con-

trary has no byssus but is equally sedentary as it bores into limestones and corals and never leaves its burrow once it has formed it.

Two species only of true Mussels grow to a considerable size in Indian waters. One of these is the very handsome Green Mussel (*Mytilus viridis*), readily recognized by the brilliant green colouration of the periostracum investing the exterior surface of the valves (Fig. 45, B.); the other is an even larger species, less elegant of contour, coated with coarse brown periostracum. The green species is widely distributed on both coasts whereas the brown one is confined, so far as I am aware, almost entirely to the extreme southern end of the peninsula—Travancore and Tinnevelly. Although the Green Mussel is to be found wherever rocky ground or oyster beds exist between low-tide level and the three-fathom line, only off the coasts of Kanara and Malabar does it find conditions sufficiently favourable to permit of it forming distinct beds; in Malabar and northern Travancore its collection is a minor marine industry. The flesh is eaten and relished by Muhammadans and Christians and by Hindus of castes inferior to the Nairs. Divers working from small dugout canoes pursue this fishery from December to May.

On the east coast the Green Mussel is found wherever beds of the Edible Oyster exist; we can clearly distinguish an *Ostrea—Mytilus viridis* association or 'formation' as it is sometimes termed.

Several medium-sized species of the Weaving Mussels (*Modiolus* spp.) exist in our seas; in Palk Bay and the pearl bank region in the Gulf of Mannar one species, the Bearded Weaving Mussel (*Modiolus barbatus*), called *suran* by the Tamil divers, is so abundant that I have seen several square miles of sea-bottom covered continuously with a carpet of these shells, felted together in a tangle of byssal threads. The presence of suran in such myriads is one of the adverse influences militating against the prosperity of our pearl fisheries; the rapidity of their growth and their habit of enveloping everything about them in a dense network of entangling fibres, contribute largely to the destruction of the more delicate pearl-oyster spat. The two molluscs have identical feeding habits and so the competition of hungry myriads of suran has the same blighting effect upon pearl-oysters as that of the American slipper-limpet upon beds of the edible oyster in English waters.

The larger species, closely related to the West Indian Tulip Mussel (*Modiolus tulipa*), is common in Palk Bay where it forms extensive beds (Fig. 45, A). The average size is not too small for food purposes, while the smaller would make, if dried and pulverized, poultry meal and fertilizer.

A very small and pretty species, *Modiolus variabilis*, characterized by the fine ribbing of the shell, lives associated with the edible oyster in backwaters and estuaries.

The Date-shells (*Lithophaga* spp.) are long cylindrical mussels, growing to a length of $3\frac{1}{2}$ in., which tunnel into limestone rocks and corals, and sometimes into massive gastropod shells (Fig. 46, B). Two of the common Indian species are *Lithophaga teres* and *L. straminea*. Date-shells bore only into shells, corals and calcareous rock, the reason being that the boring is effected mainly by means of an acid secretion poured out by glands in the mantle.

This secretion decalcifies the surface little by little and so enables the mollusc to scrape off and remove the softened debris and thereby permit of a fresh surface being attacked.

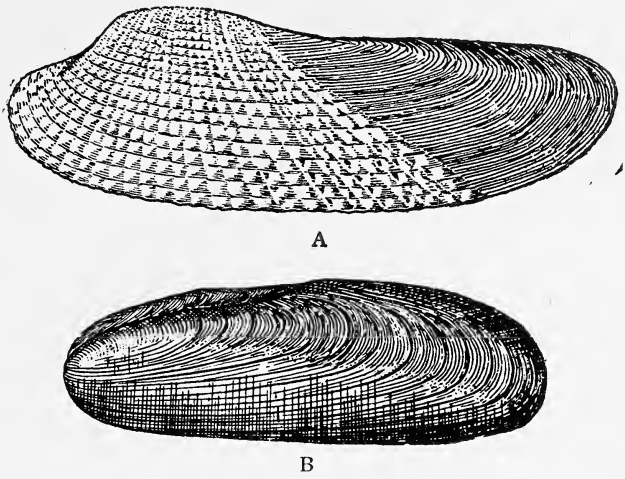

Fig. 46.—A. a typical *Pholad* (*Pholas orientalis* Gmelin.); B. a boring Mussel (*Lithophaga*). ×1.

Of the Isognomidae only one conspicuous species is found in our waters. This grows to a size of quite five inches in diameter; it is often mistaken for a large pearl-oyster. In outline it is nearly the same and the interior is lined with mother-of-pearl. The hinge is distinctive; instead of a single oblong mass as in the true pearl-oyster, the ligament is subdivided into numerous short sections, each sunk in a separate little pit or fossette. The long row of these fossettes renders Isognoma easily identifiable. It is rather rare and lives at a depth of several fathoms on rocky ground.

Pearl Oysters

The large family of the Pteriidae is of great interest to Indian students for in the waters of the Indian Ocean are found some of its best known representatives; these include several species of Pearl-oysters (*Pinctada* spp.), the Wing-shells (Pteriids proper), the Hammer-oyster (*Malleus*) and the curious *Vulsella*.

The Indian Pearl-oyster (*Pinctada vulgaris*) is amongst the smallest of its kind (Fig. 47); it seldom exceeds $3\frac{1}{2}$ in. in height and compares unfavourably in size with the huge Gold-lip (*P. maxima*) from Mergui and Australasian waters, a species with valves large enough for dinner plates. Our local species makes up in abundance for what it lacks in size; at the Ceylon pearl fishery of 1905, over 800 lakhs were fished within six weeks.

The shell is nearly straight along the hinge line and is produced at each end into a short 'ear', a modification of the wing-like projections that give the Pteriids proper their name of Wing-shells. Ventrally the shell is deep and rounded with a series of

delicate finger-like projections at the ends of radial bands made up of older fingers now outgrown, worn and disused. These pearl-oysters reach their limit of size in about $3\frac{1}{2}$ years; if they survive longer the shells become worn, the fingers disappear and the over-all length and depth actually decrease; the thickness increases until death and this dimension is therefore our best criterion to determine their age.

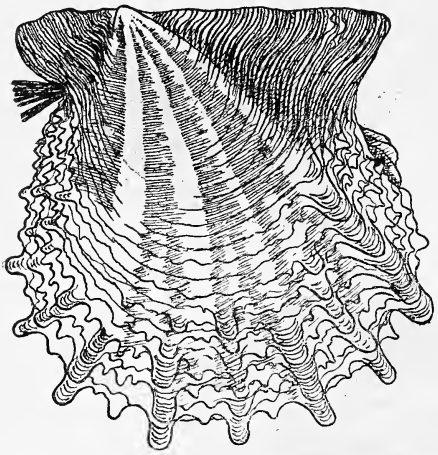

Fig. 47.—The Indian Pearl-oyster (*Pinctada vulgaris* Schum.). $\times\frac{3}{4}$.

In life-history and habits pearl-oysters are akin to mussels. A strong cable of byssal threads attaches them to rocks, stones and shells; they possess the power of casting off their cable at will; they are capable of crawling short distances and this power to shift their foothold sometimes enables them to avoid entombment through an overwash of sand. When young they are restless and inclined to shift their position frequently. I have often seen them do so six or seven times within a few hours, each place of attachment marked by a tiny tuft of golden byssal threads. The formation of one of these threads takes only a few seconds; the thread is formed from a glue-like secretion poured into a fine groove on the under side of the small tongue-shaped foot. On contact with water it coagulates into a strong, slightly elastic substance, golden yellow in young oysters, dark bronze-green in adults.

The sexes are separate but probably alternate in the same individual in successive seasons; fertilization takes place in the water. Development is rapid, a trochosphere stage first and then a veliger. At the end of about a week or even earlier if conditions are favourable, the larva settles upon the bottom and makes its first attachment. In this condition it is called 'spat'; a satisfactory 'spat-fall' is dependent upon a favourable run of currents at the time the oysters spawn, hence the irregularity of the formation of fishable beds of pearl-oysters in Indian waters. Actually the years when favourable conditions occur are less frequent than those when conditions are adverse—hence the great number of blank years in the pearl-fishing records of the Gulf of Mannar pearl-fisheries.

Pearl-oysters occur sporadically everywhere on Indian coasts but the only places where they are ever found in fishable quantities are the Gulf of Mannar, Palk Bay and the Gulf of Kutch. The greatest of these fisheries is that in the Gulf of Mannar; for over 2000 years it has been the source of intermittent wealth to the rulers of Southern India and Ceylon. That of Palk Bay is of little value for the ground is so muddy and lacking in hard bottom that

the oysters have perforce to attach to sparsely scattered dead valves of other molluscs.

In the Gulf of Kutch a pearl-fishery is carried on by His Highness the Jam Saheb of Nawanagar. The oysters there do not form beds; they occur scattered along the low-water edges of rocky reefs. They are collected by men wading in the shallows at low water of spring tides; some very valuable pearls have been found.

The origin of pearls in the Indian pearl-oyster has long been the subject of speculation and investigation. After many years' research I have had to revise my earlier conclusions[1] and now I am satisfied that the parasitic inducement of pearl formation in the Indian pearl-oyster is of comparatively rare occurrence; sand grain causation is much the more common and is to be reckoned important; a more prolific source, however, is that due to irritation caused by fragments of nacre dislodged from the inner lining of the valves by muscular strain, which pass into the oyster's soft tissues. These fragments of nacre may wander far; in their course they become invested with a containing sac of nacre-producing cells immigrant from the mantle which lay down successive coats of nacre upon the nucleus, thus forming a pearl. Other pearls, mainly of the seed-pearl kind, are formed around nuclei consisting of microscopical concretions which arise within the muscles at their place of insertion on the shell. These may also wander into the oyster's tissues and may even be found in 'nests' of as many as a dozen or more within the visceral mass. Thus pearl formation may be induced by several different kinds of irritation.

Black-lipped Pearl Oysters

Solitary individuals of the larger Black-lipped Pearl Oyster (*Pinctada margaritifera*) are occasionally found with the common species. It is a handsome, stoutly built shell with a shade of green in the very dark ground colour which is decorated characteristically with several radial lines of white spots passing outward from the umbo. 'Ears' disappear in the adult and the outline becomes suborbicular. The nacre of this species is thick enough to be of value in button making but its dark smoky colour greatly impairs its market price. It is much more numerous in the Persian Gulf than on the Indian coast.

Wing-shells

The Pteriids proper, the true Wing-shells, have usually an obliquely oval shell with enormously developed ears at each end of the hinge. Several species may be termed common on rough bottom but they never form beds or banks.

Usually they are semi-commensal, living with particular kinds of sea-fans and hydroid zoophytes. Two characteristic species with this habit are the brown *Pteria radiata* and the brown and white striped *P. zebra*. The former is a typical Wing-shell, the hinder ear prolonged into a huge backwardly directed spine. It is found upon the branches of stout sea-fans (Gorgonids), usually

[1] Herdman, Sir W. A. and Hornell, J. *Ceylon Pearl Oyster Reports*, vol. iii. pp. 49-56. Royal Society, London, 1905.

coloured brownish orange. When young this Pteriid has the identical rich orange colouration of the sea-fan; its concealment is further aided by the elongated shape of the ears—these simulate branches of the host; shape and colour are so similar that the young readily escape observation on casual examination. With growth these resemblances become obscured, the Wing-shells tak-

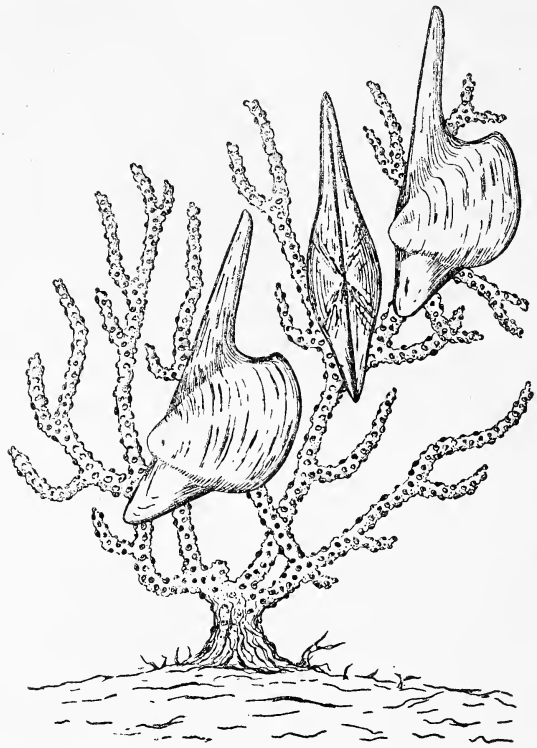

Fig. 48.—*Pteria radiata* Pease, commensal upon a Gorgonid Sea-fan.

ing on darker colour as their shell becomes too stout to escape detection. By that time they cease to be acceptable morsels to

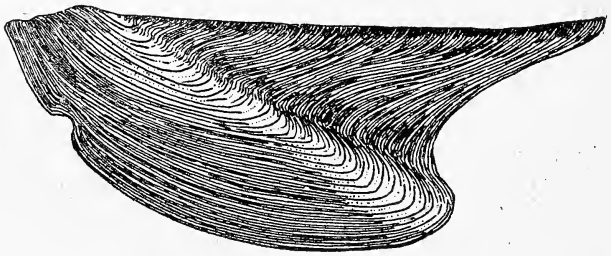

Fig. 49.—A Wing-Shell (*Pteria inquinata* Reeve).

the small fishes that prey upon them when the shell is small and thin.

The Zebra Wing-shells (*P. zebra*) are still more adept at mimi-

cry; they live chiefly upon a tall zoophyte, *Halichornaria insignis*. The host has stoutly built pinnate branches of a deep brown colour. Upon these the little Zebra Wing-shells often congregate in numbers, their shells, striped brown and white, exactly simulating the brown pinnules and the colourless spaces between—precisely the same idea as is exploited by the tiger and the zebra; against their usual background they are indistinguishable at a distance.

The smallest of our Wing-shells is *Pteria vexillum*, known in old pearl-oyster reports as 'false spat', for it was mistaken times without number for the spat of the true pearl-oyster, thereby raising unfounded hopes of great pearl fisheries in the near future. It is a tiny shell, seldom more than one-third of an inch long. It occurs frequently in immense numbers in the pearl bank region, clustering in untold millions on seaweeds and zoophytes. While quite young it is difficult to distinguish it from real pearl-oyster spat; only as growth proceeds do points of difference emerge.

The Hammer Oyster

Closely related to the Wing-shells is the Hammer Oyster (*Malleus vulgaris*), a black, misshapen corrugated shell shaped like the letter T. The crossbat at the top represents the two enormously developed ears, the upright, the high narrow body. When young it has the general form and habits of a Pteriid. With increasing age it changes gradually into the monstrous form of the adult, twisted, rough and wrinkled, and usually overgrown with a crust of sponges, hydroids, polyzoa and ascidians—a happy hunting ground for the zoologist. Like all Pteriids a portion of the inner lining of the valves is nacreous; but here it is smaller in area and thinner than usual.

Last of the family is the curious *Vulsella rugosa*, a deep oblong shell without ears. It lives imbedded in sponges, not singly but in numbers, so much so that an 'association' appears to have sprung up between the two, in the same way and for the same reason that the Vermetid gastropod *Siliquaria* forms a similar association with another species of sponage *Vulsella* is particularly common on rough ground in depths of three to five fathoms. No typical byssus is formed; some authorities consider its differences from the true Pteriids sufficient to entitle it to be put in a special family by itself —the Vulsellidae.

The Scallops

The Scallops (Pectinidae) are not well represented in Indian waters and are all small and insignificant unless we include the magnificent smooth-shelled *Amussium*, which by some is placed in a separate family, the Amussiidae.

The true Scallops, such as the common *Chlamys senatoria* have a deeply ribbed shell, usually oval in plan, with two well-developed and conspicuous ears. In the young condition some attach themselves to rocks and stones by means of a byssus; when adult they usually abandon this habit and lie free, resting upon the right or convex valve. They have uncommonly active habits for Lamellibranchs, especially when quite young, when some species dart through the water by the alternate and rapid opening and shutting

of their valves. Even the adults have considerable power of shifting position in this way. Probably correlated with this unusual activity is the presence of highly developed minute eyes upon the mantle edge. These are placed on the ends of short marginal tentacles at irregular intervals among the longer tentacular filaments margining the gape of the shell. They are always more numerous on the left or superior lobe; in colour they are brilliantly iridescent green, very conspicuous and arresting when the animal is watched alive. In structure they are as complicated and perfect in basic design as the human eye, with a cornea, crystalline lens and retina of complex plan with a well-developed optic nerve. There is no question of the functional value of such eyes; they are made to see with and are valuable for the purpose of warning their owner of the approach of danger, independently of touch.

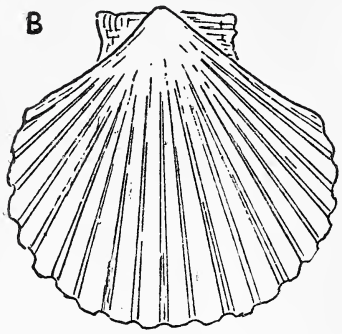

Fig. 50.—A Common Indian Scallop (*Chlamys senatoria* Gmelin.).

The colouration of scallop shells is characteristically vivid; red, brown and yellow predominate but these are believed to be of no special significance. Handsome as are the smaller of the Pectens, met with in shallow water, they cannot compare in elegance with the lovely porcellaneous *Amussium pleuronectes,* met with in deeper water in the Bay of Bengal off the Ganjam and Orissa coast. Unlike the true Pectens its valves are smooth externally, highly polished and handsomely decorated with reddish brown. The dredge is necessary to procure it.

The Thorny Oysters

The Thorny Oysters (Spondylidae) resemble the Scallops in anatomy, even to the presence of eyes bordering the mantle, but they have abandoned a free life completely. The valves are both ornamented with long spines (Fig. 51), and those of the lower (right) valve become cemented more or less extensively to a rock or boulder.

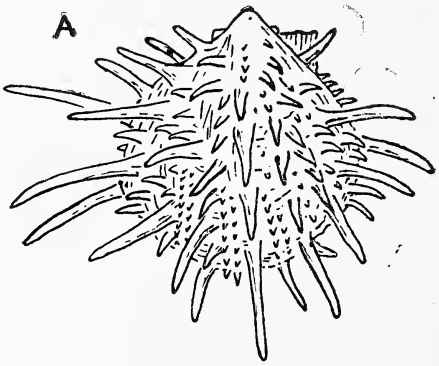

Fig. 51.—The Thorny Cockle (*Spondylus* sp.).

Spondylus is a fairly common shell on rocky ground and among coral reefs, where its brilliant red or yellow valves, decorated with radial ribbing of long spines, are conspicuous. It relies upon quickness of sight and upon the strength and spiny defences of its shell to defy enemies. That its valves may not be

wrenched apart by main force, a locking arrangement of the hinge is devised. The ligament is a stout pad lodged centrally in a deep triangular pit in the hinge area, with two very stout interlocking teeth in each valve, guarding the ligament. The adductor muscle is also specially strong.

(To be continued.)

A BIRD COUNT IN DEHRA DUN

BY

(Mrs.) M. D. WRIGHT

(*With a sketch map and a table*)

Attempts at making a census of the bird population of a country, or part of a country, have been made in Britain, America and Europe. They have in some degree been successful as a result of nation wide co-operation. One of the chief aims of them is to show up which species are on the decrease in numbers, in danger of extinction and therefore in need of special protection.[1]

In India which has one of the most wonderful avifaunas in the world, great difficulties lie in the way of such an achievement.

Most counts for censuses are taken by counting the pairs of nesting birds in a given locality and calculating their numbers on an acreage basis.

Encouraged by Mr. Sálim Ali, and having read of methods in counting in Hickey's 'A Guide to Bird Watching', I set out to experiment in counting. As the usual methods were not possible for me to work at without any help at all, I have made an attempt at one on my own lines in order primarily to keep a more accurate check on the birds of my general study area. The area of the count therefore is a small portion of my general study area.

Description of Counting Area. (See sketch map)

The area of the count is a flat strip of open cultivation in the Tons valley, 1900 ft. above sea level. It is about 1 mile long by 600 yds. wide at its widest part.

The Tons River which forms its northern boundary is a tributary of the Ahsan River which flows into the Jumna. It is dry for nearly half the year—a typical boulder-strewn hill river.

The southern boundary is a cliff rising up from the valley covered with thick scrub jungle. No birds from here have been included unless they ventured into the open field of the count at the time of counting.

Vegetables and crops are grown in rotation, and irrigation is by sewage brought down from the Sewage Farm above the cliff, thus causing it to be an attractive feeding ground for birds. Hedges between the fields and scattered trees give cover, building sites and resting perches for birds. A small mango grove, which shelters two village huts, is an added attraction.

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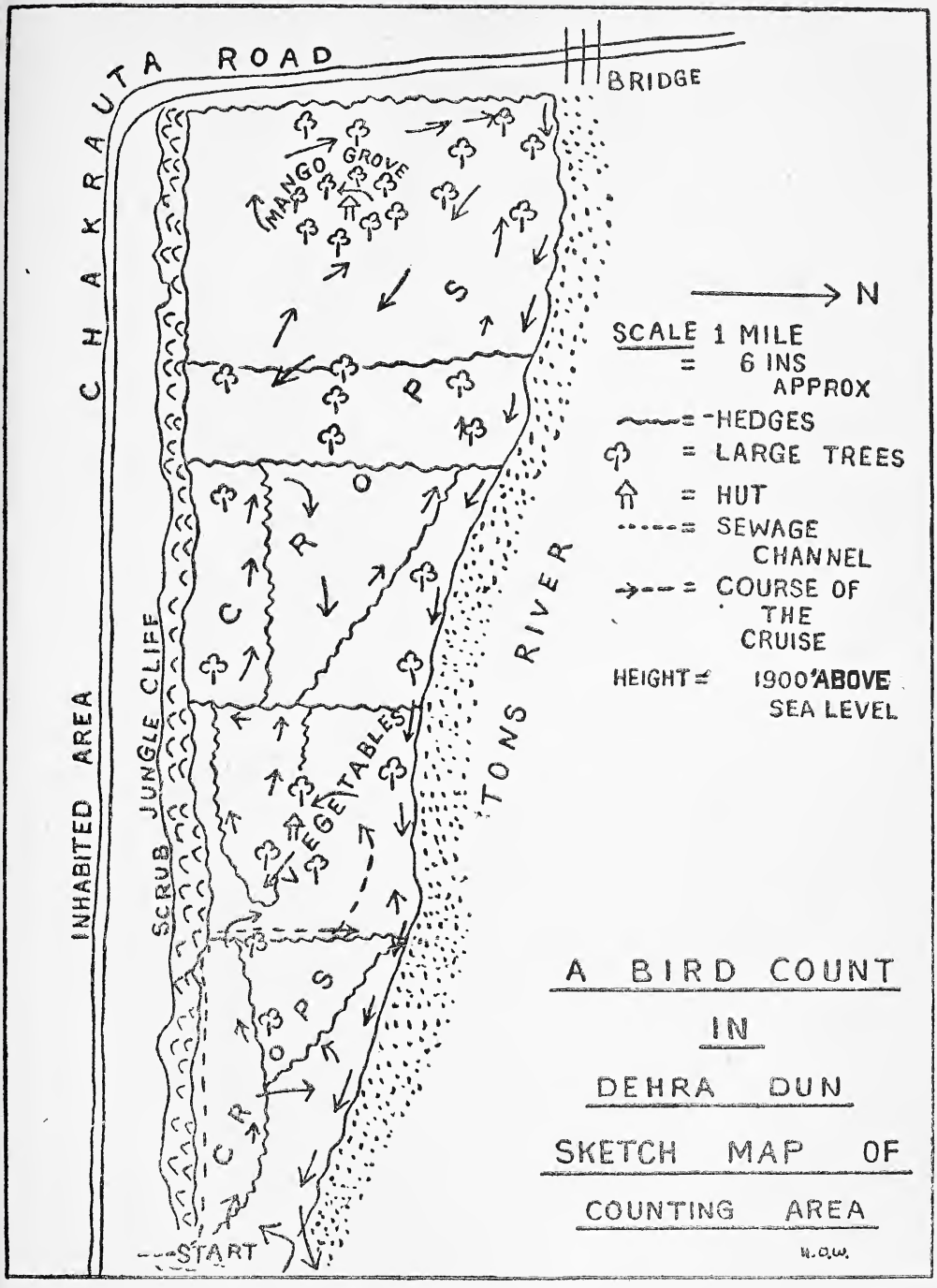
[1] Also, of course, to determine the significance of individual species as economically harmful or beneficial. A study of the food and feeding habits by itself is inadequate unless the local population density of the investigated species is ascertained.—EDS.


CHAKRAUTA ROAD
BRIDGE
MANGO GROVE
CROPS
CROPS
CROPS
VEGETABLES
INHABITED AREA
SCRUB JUNGLE CLIFF
TONS RIVER
START
N
SCALE 1 MILE = 6 INS APPROX
= HEDGES
= LARGE TREES
= HUT
= SEWAGE CHANNEL
= COURSE OF THE CRUISE
HEIGHT = 1900' ABOVE SEA LEVEL
A BIRD COUNT IN DEHRA DUN
SKETCH MAP OF COUNTING AREA
H.O.W.

Aims of The Count.

1. To make an accurate *minimum* census of species of birds that are residents or visitors to that area throughout the course of one year.

2. To keep a check on :—

The Visitors—noting their arrivals and departures, whether these were sudden or gradual, and periods of greatest and least abundance.

The Residents—noting times of courtship, nesting and rearing of young, whether strictly resident or partially migratory.

3. To note the effect of changes of weather and vegetation on the bird population.

4. To note the time of year of maximum and minimum

(*a*) Total number of birds.

(*b*) Total numbers of species of birds.

Apart from the evidence of figures, frequent watching of birds in the same area throws light on

Territorial habits of some species,

Preference of species for a particular type of country or food.

Changes in plumage, and many other interesting aspects of bird behaviour.

Method of Counting.

1. The period covered was from March 1948 to February 1949.

2. Usually the counts were taken with an interval of not more than four days between each.

3. The same course was taken for each 'cruise'. Moving from east to west in a north-south zigzag and returning east along the edge of the river.

4. During each cruise identified birds were marked down with minimum numbers where seen on a rough chart of the area. These numbers when added up under headings of species were made into a monthly list together with notes on prevailing conditions of weather, vegetation etc. at the time of the cruise.

5. Each half of the month an average was taken of the figures for each species, making usually two averages a month. These are the figures recorded.

6. A few adjustments in making the averages seemed necessary and were accordingly made as follows :—

When there were over 100 birds of a particular species only 100 was recorded.

If a solitary member of a species was seen on only one count, it was recorded as 1 in the average for that half of the month due to the probability of its still being about.

The averages were taken to the nearest bird to avoid arriving at fractions of a bird !

Warblers, Pipits and Snipe have been counted collectively under those headings due to the difficulty of differentiating between the different species of them when partly hidden by foliage and in flight.

7. Only those birds on or in flight over the near edge of the Tons river have been included. Unidentified birds have not been included.

It is to be hoped that there will be many experiments in bird counting in India. If they could be made in adjacent districts over a period of years, results would be of real value. Mr. C. G. Webb-Peploe's 'A Census of Nests in a private Bird Sanctuary' (*Journal B.N.H.S.* Vol. 47, No. 4) is a fine example of what can be done on a private estate where real protection of nesting birds can be maintained along with education to the young of the country.

			15°.		10°.	0°–43°.	0°–41°.	–47°.
[illegible]. Psittacul	[illegible]	20	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]
2. Athene b	...	...	...	...	...	1	2	2
03. Glaucidiu	1	2	1	1	2	1	1	...
04. Sarcogyp	...	...	...	...	...	1	1	1
105. Gyps fulv	...	1	1	...	1	...	1	1
106. Pseudogy	...	...	...	...	...	...	...	...
107. Neophron	2	1	...	4	1	...	3	..
108. Aquila ra	4	9	6	5	5	5	4	6
109. Aquila ch	1	1	...	...	...	...	...	...
110. Hieraetus	...	...	...	1	1	1	1	...
111. Haliastur	1	1	1	1	1	1	1	1
112. Milvus m	...	...	...	...	...	...	...	...
113. Elanus c	2	2	2	3	3	2	3	1
114. Circus æ	...	...	...	...	...	...	...	...
115. Circus m	...	...	...	...	...	...	...	...
116. Astur ba	...	...	...	...	...	...	...	...
117. Accipiter	1	1	...	...	...	...	...	...
118. Falco ch	...	...	1	...	...	...	...	...
119. Crocopus	...	...	...	1	...	...	...	...
120. Columba	...	...	...	...	...	...	...	...
121. Streptop	...	...	...	...	...	...	...	...
122. Streptop	...	...	...	...	...	...	...	...
123 Streptop	10	12	8	8	25	30	13	14
124. Streptop	3	10	18	19	22	8	7	6
125. Œnopope	1	1	2	3	1	1	...	1
126. Chalcopl	2	1	...	...	...	1	...	1
127. Gallus g	...	...	...	...	...	1	...	...
128. Perdicula	...	1	...	...	...	...	...	1
129. Francoli	1	2	3	1	...	...	1	...
130. Turnix s	...	...	...	1	...	...	...	...
131. Lobivane	2	...	...	...	...	...	...	...
132. Hoplopte	6	12	12	11	17	15	8	1
133. Charadri	1	...	...	...	...	...	...	...
134. Actitis h	1	1	...	2	...	...	1	...
135. Tringa o	2	1	1	1	1	...	...	...
136. Erolia te	5	6	6	5	3	1	2	...
137. Capella	1	...	...	...	...	...	...	...
138. Dissoura	...	1	...	...	...	...	...	...
139. Ciconia	...	...	...	...	1	...	...	...
140. Ardeoia	...	1	...	1	...	...	...	...
141. Nycticor	4	2	4	2	4	1	1	1
142. Nettion	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...
	477	592	570	524	445	411	347	301
	79	73	73	75	68	64	68	58

No.	Key to Data. Month—Between dates; No. of counts; average weather conditions; average maximum minimum temperature. / Prominent features of the field. / Time between which counts were made.	March '48. 3–13. C. 4. Spells of rain. 73·3°–52°. Crops in ear, standing high. Wheat & Oats. 9. 30–11. 45 hrs.	March. 15–30. C. 5. Fine, warmer. 77°–46°. Crops ripening. 7. 30–12. 10 hrs.	April. 2–13. C. 4. Fine, dry. 92°–55°. Harvest begun. 6. 15–10. 30 hrs.	April. 17–30. C. 3. Fine, hot. 100°–67°. Harvest. 6. 15–9. 45 hrs.	May. 4–15. C. 4. Unsettled, hot. 101°–68°. Remains of harvest. Irrigation of vegetables. 6. 5–8. 20 hrs.	May. 18–28. C. 4. Oppressive, hot. 106°–70°. Fields burnt & ploughed, small sewage swamp. 6–8. 30 hrs.	June. 1–19. C. 4. 104°–74·5°. Ploughing. Hot, unsettled. 6–9. 30 hrs.	June. 22–29. C. 3. 94°–75°. Break of rains. Ploughing & sowing rice. 6–9. 20 hrs.	July. 2–14. C. 4. Rains. 90·5°–73·5°. Rice sprouting. Indian corn ripe. 6.0–8. 15 hrs.	July. 18–30. C. 5. Overcast, rains. 86°–73°. Sowing of rice. River flowing. 6. 0–11 hrs.	August. 3–6. C. 2. Overcast, rains. 83·5°–73°. Crops sprouting. 6. 40–9. 20.	September. 7–14. C. 1. Fine. Intervals. 85·5°–70°. Juar crops tall. 6. 30–12 hrs.	September. 17–29. C. 4. Wet spells. 86°–70°. Crops ripening. Trees in fruit. 6. 30–10 hrs.	October. 1–12. C. 1. Unsettled. 85°–65·5°. Crops ripening, harvest begun. 6. 45–11 hrs.	October. 16–30. C. 5. Fine. 75°–58·5°. Harvest. Ploughing & sowing. 7–11 hrs.	November. 2–14. C. 4. Fine. 75°–50°. Harvest. Ploughing & sowing. 7. –10. 30 hrs.	November. 17–29. C. 4. Fine, colder. 69·5°–45°. Rice harvest over, early wheat up. 7–10. 30 hrs.	December. 2–16. C. 4. Mostly fine. 67°–41·5°. Sewage irrig. of young wheat. 7. 15–10. 45 hrs.	January '49. 8–15. C. 4. Fine, frosty. 70°–40°. Irrigation of wheat. River dried up. 7. 30–10. 50 hrs.	January. 22–29. C. 3. Stormy, snow on hills. 62°–43°. Wheat & oats growing fast. 7. 30–10–30.	February. 1–15. C. 4. Wet; snow on hills. 67°–41°. Little irrigation. River flowing again. 7. 20–10. 10 hrs.	February. 19–27. C. 3. Fine but cloudy. 74°–47°. Crops in ear. River dry. 7. 20–9. 10 hrs.
1.	Corvus macrorhynchos. Jungle Crow	7	17	9	8	9	9	7	7	5	11	11	11	17	15	16	19	23	47	28	20	16	30
2.	Corvus splendens. House Crow	2	1	3	1	...	...	3	5	2	2	...	1	1	5	1	8	8	18	6	4	1	1
3.	Dendrocitta vagabunda. Indian Tree-Pie	...	...	...	...	...	...	...	...	...	...	...	1	1	2	1	1	...	...	1	1	1	...
4.	Parus major. Indian Grey Tit	1	1	2	1	...	...	...	...	1	1	1	2	1	2	2	5	4	1	3	4	1	1
5.	Turdoides somervillei. Jungle Babbler	6	13	13	9	6	12	12	7	7	15	11	8	7	11	12	6	6	13	7	4	11	5
6.	Argya caudata. Common Babbler	1	1	1	1	1	2	1	2	2	5	3	...	6	6	6	6	1	8	2	3	...	3
7.	Pomatorhinus erythrogenys. Rusty-cheeked Scimitar Babbler	...	...	...	1	...	1	...	...	...	1	...	...	1	1	1	1	1	1	1	...	2	1
8.	Chrysomma sinensis. Yellow-eyed Babbler	1	2	2	4	4	3	5	5	4	1	3	5	1	8	6	8	1	...	...	3	...	1
9.	Pellorneum ruficeps. Spotted Babbler	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10.	Molpastes cafer. Red-vented Bulbul	18	9	19	17	16	12	14	20	15	16	10	8	17	11	12	16	7	6	5	3	7	7
11.	Molpastes leucogenys. White-cheeked Bulbul	2	1	2	1	...	1	1	1	2	2	1	...	3	1	1	2	4	1	2	...	1	...
12.	Certhia himalayana. Himalayan Tree-Creeper	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...
13.	Tichodroma muraria. Wall-Creeper	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	1	...
14.	Saxicola caprata. Pied-Bush-Chat	7	3	3	3	2	2	5	5	2	1	...	...	1	1	1	1	1	2	2	1	2	...
15.	Saxicola torquata. Stonechat	2	1	1	...	...	...	...	...	...	...	...	...	...	1	1	3	4	4	3	2	2	3
16.	Rhodophila ferrea. Dark-grey Bush-Chat	3	1	...	...	...	...	...	...	...	...	...	...	...	2	8	6	5	6	8	5	5	4
17.	Phoenicurus ochruros. Black Redstart	1	...	1	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...
18.	Chaimarrhornis leucocephala. White-capped Redstart	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	1	1	1
19.	Rhyacornis fuliginosa. Plumbeous Redstart	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1	1	...	...	...
20.	Cyanosylvia svecica. Bluethroat	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	6	6	5	1	2	3	...
21.	Calliope pectoralis. Himalayan Rubythroat	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
22.	Saxicoloides fulicata. Indian Robin	...	...	...	...	...	...	...	1	1	2	1	2	1	1	1	2	1	1	1	1	1	1
23.	Copsychus saularis. Magpie Robin	1	1	1	1	4	4	5	8	6	1	6	1	2	3	2	3	2	3	2	1	2	1
24.	Myophonus coeruleus. Himalayan Whistling Thrush	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	1	1
25.	Turdus atrogularis. Black-throated Thrush	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4
26.	Siphia parva. Red-breasted Flycatcher	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	1	1	...
27.	Eumyias thalassina. Verditer Flycatcher	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
28.	Tchitrea paradisi. Paradise Flycatcher	...	...	2	5	4	4	6	2	1	1	...	1	1	1	...	...	...	...	...	...	...	...
29.	Muscicapula tricolor. Slaty-blue Flycatcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	...	...	1	1
30.	Rhipidura aureola. White-browed Fantail Flycatcher	1	2	2	1	...	...	1	2	2	2	2	1	1	2	1	1	1	1	1	1	1	1
31.	Rhipidura albicollis. White-throated Fantail Flycatcher	...	...	...	1	2	1	1	1	1	...	...	...	...	...	1	1	1	2	1	...	1	1
32.	Chelidorhynx hypoxanthum. Yellow-bellied Fantail Flycatcher	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	1
33.	Lanius vittatus. Bay-backed Shrike	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34.	Lanius schach. Rufous-backed Shrike	5	6	8	7	4	5	4	5	7	6	6	9	10	6	5	5	5	6	7	7	9	6
35.	Hemipus picatus. Brown-backed Pied Shrike	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36.	Pericrocotus brevirostris. Short-billed Minivet	2	7	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...
37.	Pericrocotus peregrinus. Little Minivet	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
38.	Lalage melaschista. Dark-grey Cuckoo-Shrike	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
39.	Graucalus javensis. Large Cuckoo-Shrike	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	3	2	...	...
40.	Dicrurus macrocercus. King-Crow	1	5	6	8	6	7	6	8	5	7	1	3	4	5	2	2	1	3	3	3	4	4
41.	Orthotomus sutorius. Tailor Bird	1	1	...	1	1	2	...	1	2	2	3	2	2	1	1	3	2	2	1	2	1	...
42.	Franklinia gracilis. Franklin's Wren-Warbler	20	23	16	4	2	...	...	...	...	4	...	2	6	6	21	11	1	16	11	12	9	13
43.	Prinia socialis. Asby Wren-Warbler	1	2	4	6	5	6	5	5	6	1	7	4	1	3	4	4	5	2	1	1	1	2
44.	Prinia sylvatica. Jungle Wren-Warbler	...	...	...	...	1	2	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45.	Prinia inornata. Indian Wren-Warbler	1	2	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
46.	Sylviidæ. Other Warblers	1	21	41	18	12	4	1	...	...	...	...	2	3	5	11	15	17	15	9	6	7	5
47.	Oriolus oriolus. Golden Oriole	...	...	1	4	1	5	5	1	5	4	2	1	1	...	...	...	...	...	...	...	...	...
48.	Sturnus vulgaris. Starling	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	17	13	9	19	6	2
49.	Sturnia malabarica. Grey-headed Mynah	...	1	3	...	1	3	2	...	...	...	3	3	12	6	1	...	...	...	...	...	...	...
50.	Temenuchus pagodarum. Brahminy Mynah	2	7	15	15	12	18	15	16	2	41	7	6	12	1	...	1	1	1	1	...	1	2
51.	Acridotheres tristis. Common Mynah	21	23	37	35	32	23	33	36	24	25	26	19	20	15	51	42	85	51	53	31	35	36
52.	Acridotheres ginginianus. Bank Mynah	1	1	1	...	2	...	...	...	...	...	...	1	2	1	2	...	4	3	8	15	4	...
53.	Aethiopsar fuscus. Jungle Mynah	21	22	12	15	16	17	17	32	6	15	25	38	22	22	21	17	31	31	34	41	22	26
54.	Sturnopastor contra. Pied Mynah	4	4	7	6	4	2	3	3	1	2	14	41	43	22	9	19	20	11	11	10	8	6
55.	Ploceus philippinus. Baya Weaver-Bird	...	...	...	...	1	1	1	...	...	2	2	...	...	...	1	1	1	...	...	...	...	...
56.	Uroloncha punctulata. Spotted Munia	...	...	...	2	11	31	21	8	...	7	2	...	4	3	3	...	...	...	...	...	...	...
57.	Carpodacus erythrinus. Common Rosefinch	...	2	20	8	4	...	...	...	...	...	...	4	25	17	1	...	5	1	...	...	...	...
58.	Gymnorhis xanthocollis. Yellow-throated Sparrow	...	4	18	28	21	30	35	31	43	2	...	...	...	...	...	...	...	...	...	...	...	...
59.	Passer domesticus. House Sparrow	...	1	2	7	18	13	9	4	13	26	32	...	5	4	7	2	5	2	...	...	1	...
60.	Melophus lathami. Crested Bunting	...	...	...	1	1	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
61.	Metoponia pusilla. Gold-fronted Finch	3	22	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
62.	Riparia chinensis. Indian Sand-Martin	3	2	2	1	4	2	4	2	1	5	3	1	4	11	4	3	1	2	1	1	4	1
63.	Riparia rupestris. Crag-Martin	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
64.	Hirundo smithii. Wire-tailed Swallow	...	...	...	...	1	1	1	1	...	1	1	3	1	2	6	...	...	...	...	...	...	...
65.	Hirundo daurica. Red-rumped Swallow	1	1	1	1	...	1	3	...	1	1	3	5	18	9	78	100	88	38	...	1	4	1
66.	Motacilla alba. White Wagtail	8	5	1	4	...	...	...	...	...	...	...	12	18	15	29	29	24	31	35	26	29	25
67.	Motacilla maderaspatensis. Pied Wagtail	...	...	...	...	...	...	...	1	1	...	2	...	2	1	2	1	1	1	1	2	1	...
68.	Motacilla cinerea. Grey Wagtail	...	1	1	1	...	...	...	...	...	...	...	4	4	4	3	3	2	2	2	2	1	1
69.	Motacilla flava. Yellow Wagtail	...	...	...	1	3	1	...	...	...	...	...	2	6	1	3	9	8	4	2	1	1	...
70.	Motacilla citreola. Yellow-headed Wagtail	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
71.	Anthus spp. Pipits	...	...	...	...	...	1	1	2	1	1	...	...	2	1	21	24	33	55	...	64	46	37
72.	Galerida cristata. Crested Lark	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	47	...	...	...
73.	Eremopteryx grisea. Ashy-crowned Finch-Lark	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
74.	Zosterops palpebrosa. White-eye	2	3	2	6	5	6	6	3	3	2	2	...	4	10	4	...	3	1	...	...	2	1
75.	Cinnyris asiaticus. Purple Sunbird	1	1	1	1	2	1	2	1	1	1	...	...	...	...	...	...	...	...	...	...	...	1
76.	Piprisoma agile. Thick-billed Flowerpecker	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
77.	Brachypternus benghalensis. Golden-backed Woodpecker	...	1	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...
78.	Chrysocolaptes guttacristatus. Crimson-backed Woodpecker	1	1	1	1	1	1	...	...	...	1	...	1	1	1	1	...	1	1	1	...	1	1
79.	Jynx torquilla. Wryneck	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80.	Megalaima zeylanicus. Green Barbet	...	...	2	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
81.	Megalaima haemacephala. Coppersmith	...	...	...	...	1	...	1	1	...	1	1	1	1	1	...	1	2	2	...	...	...	...
82.	Coracias benghalensis. Blue Jay	1	1	2	1	2	3	3	2	3	2	1	3	8	1	1	...	1	...	...	...	...	1
83.	Merops orientalis. Green Bee-eater	4	1	4	3	3	5	6	14	5	3	1	2	2	3	3	3	3	3	5	4	4	4
84.	Merops superciliosus. Blue-tailed Bee-eater	14	7	11	9	12	11	11	8	12	11	11	13	17	15	...	...	...	...	...	...	...	2
85.	Alcemerops athertoni. Blue-bearded Bee-eater	...	...	6	29	23	16	13	10	13	2	10	5	4	...	...	...	...	...	...	...	...	...
86.	Ceryle lugubris. Himalayan Pied Kingfisher	...	...	1	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...
87.	Alcedo atthis. Common Kingfisher	...	...	...	...	...	...	...	...	...	1	1	...	1	1	1	1	1	1	1	1	1	...
88.	Halcyon smyrnensis. White-breasted Kingfisher	...	...	1	...	...	...	...	...	...	...	...	2	...	1	1	1	1	1	1	...	...	...
89.	Tockus birostris. Grey Hornbill	1	1	2	1	1	1	1	1	1	3	4	3	2	1	1	2	1	2	3	3	3	3
90.	Upupa epops. Hoopoe	...	...	...	...	...	...	...	...	...	3	...	...	1	1	1	1	1	1	1	1	1	1
91.	Micropus affinis. Indian Swift	3	1	1	1	1	2	3	4	1	1	1	...	2	1	1	2	8	3	6	7	6	5
92.	Cuculus canorus. Cuckoo	...	...	8	4	1	11	1	3	3	1	2	3	1	...	...	...	...	...	...	...	...	...
93.	Clamator jacobinus. Pied-crested Cuckoo	...	...	...	1	1	2	2	2	2	1	...	...	...	...	...	...	...	...	...	...	...	...
94.	Cuculus micropterus. Indian Cuckoo	...	...	...	...	...	...	...	1	2	1	...	1	1	1	...	...	...	...	...	...	...	...
95.	Eudynamis scolopaceus. Koel	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
96.	Surniculus lugubris. Drongo-Cuckoo	...	...	...	1	1	1	1	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...
97.	Taccocua leschenaultii. Sirkeer	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
98.	Centropus sinensis. Crow-Pheasant	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
99.	Psittacula krameri. Green Parrakeet	...	...	...	1	1	...	1	1	...	...	...	...	1	1	1	1	1	1	1	1	...	1
100.	Psittacula cyanocephala. Blossom-headed Parrakeet	2	2	15	31	17	7	10	29	32	22	23	2	9	11	14	24	2	11	6	2	11	9
101.	Psittacula himalayana. Slaty-headed Parrakeet	2	6	9	9	7	8	13	29	22	15	41	9	15	10	13	30	23	1	1	1	—	3
102.	Athene brama. Spotted Owlet	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...
103.	Glaucidium radiatum. Jungle Owlet	3	3	2	2	...	1	1	...	1	1	...	1	1	1	1	2	1	1	2	1	2	2
104.	Sarcogyps calvus. King Vulture	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...
105.	Gyps fulvus. Griffon Vulture	...	...	...	...	1	...	1	...	...	1	...	...	...	...	...	1	1	...	1	...	1	1
106.	Pseudogyps bengalensis. White-backed Vulture	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
107.	Neophron percnopterus. Neophron	...	...	1	...	1	...	1	...	...	6	1	3	...	1	2	1	...	4	1	...	3	...
108.	Aquila rapax. Tawny Eagle	4	4	1	10	9	8	6	4	5	5	2	4	6	5	4	9	6	5	5	5	4	6
109.	Aquila chrysaetus. Golden Eagle	...	...	1	...	...	...	...	...	...	...	...	1	...	1	1	1	...	...	...	...	...	...
110.	Hieraetus fasciatus. Bonelli's Eagle	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...
111.	Haliastur indus. Brahminy Kite	1	1	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	1	1	1	1	1
112.	Milvus migrans. Common Pariah Kite	...	...	...	...	...	...	1	...	...	1	1	1	1	1	...	...	...	...	...	...	...	...
113.	Elanus caeruleus. Black-winged Kite	2	2	2	3	3	4	3	3	3	1	2	2	3	3	2	2	2	3	3	2	3	1
114.	Circus aeruginosus. Marsh Harrier	...	...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
115.	Circus macrourus. Pale Harrier	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
116.	Astur badius. Shikra	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
117.	Accipiter virgatus. Besra Sparrow Hawk	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...
118.	Falco chiquera. Red-headed Merlin	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...
119.	Crocopus phoenicopterus. Common Green Pigeon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
120.	Columba livia. Blue Rock Pigeon	...	...	...	...	...	...	...	1	3	...	3	...	...	...	...	...	...	...	...	...	...	...
121.	Streptopelia orientalis. Rufous Turtle Dove	...	...	...	...	...	...	...	...	...	7	26	...	...	...	...	...	...	...	...	...	...	...
122.	Streptopelia chinensis. Spotted Dove	...	...	...	1	...	...	...	...	...	1	3	...	...	1	...	...	...	...	...	...	...	...
123.	Streptopelia decaocto. Indian Ring Dove	4	6	10	24	28	21	22	27	20	18	11	10	15	18	19	12	8	8	25	30	13	14
124.	Streptopelia senegalensis. Little Brown Dove	7	9	6	3	1	2	3	3	3	4	5	5	4	5	3	10	18	19	22	8	7	6
125.	Oenopopelia tranquebarica. Red Turtle Dove	...	1	2	1	...	...	1	1	...	...	1	...	1	1	1	1	2	3	1	1	...	1
126.	Chalcophaps indica. Emerald Dove	2	3	5	10	7	8	8	5	4	2	3	2	2	1	2	1	...	...	...	1	...	1
127.	Gallus gallus. Red Jungle Fowl	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...
128.	Perdicula asiatica. Jungle Bush-Quail	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
129.	Francolinus pondicerianus. Grey Partridge	2	3	1	3	1	...	1	...	1	2	...	1	1	1	1	2	3	1	...	...	1	...
130.	Turnix sylvatica. Little Button Quail	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
131.	Lobivanellus indicus. Red-wattled Lapwing	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...
132.	Hoplopterus duvaucelii. Spur-winged Plover	4	1	3	1	1	1	1	1	1	1	2	1	3	3	6	12	12	11	17	15	8	1
133.	Charadrius dubius. Little Ring-Plover	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
134.	Actitis hypoleucos. Common Sandpiper	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	2	...	...	1	...
135.	Tringa ochropus. Green Sandpiper	1	...	...	...	...	...	...	...	...	...	...	...	...	2	2	1	1	1	1	...	...	...
136.	Erolia temminckii. Temminck's Stint	...	...	...	1	...	...	...	...	1	1	1	5	7	4	5	6	6	5	3	1	2	...
137.	Capella spp. Snipe	...	...	...	...	...	...	...	...	...	...	...	11	5	4	1	...	...	...	...	...	...	...
138.	Dissoura episcopus. White-necked Stork	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...
139.	Ciconia nigra. Black Stork	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
140.	Ardeola grayii. Pond Heron	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...
141.	Nycticorax nycticorax. Night Heron	...	...	...	...	...	1	1	1	1	2	4	3	6	12	4	2	4	2	4	1	1	1
142.	Nettion spp. Teal	...	...	...	...	...	...	1	1	2	2	4	...	...	3	...	...	...	...	...	...	...	...
	Total of Averages	228	289	371	396	365	392	368	380	329	319	373	332	431	391	477	592	570	524	445	411	347	301
	Total No. of Species	57	62	66	68	62	61	62	57	55	65	55	60	75	80	79	73	73	75	68	64	68	58

REVIEWS

1. INDIAN HILL BIRDS by Sálim Ali. Pp. lii + 188. 64 coloured plates by G. M. Henry, 8 photographic plates, end maps. Size 7″×5″ Bombay—Oxford University Press, 1949. Price Rs. 20.

To supplement his *Book of Indian Birds,* which concentrates on the birds of the plains and human settlements, Sálim Ali has now given us an excellent practical guide to the hill birds. By far the most useful feature of this guide is the series of 64 coloured plates with representations of 117 species of birds. This includes not only all the more common species of hill birds but also a representative of nearly every genus. By reference to an illustrated species it is thus easy to describe in the text many additional species that could not be accommodated on the plates. G. M. Henry reveals himself in these plates as one of our foremost bird illustrators. His plates of the Emerald Dove, of the Blue-bearded Bee-eater, and of the White-throated Fantail-flycatcher rank among the best bird portraits.

The information given in the text emphasizes facts that help in identification, such as voice and habitat. It is somewhat confusing to have mixed in with the field characters the descriptions of similar species, often not even distinguished by a separate paragraph. It would have helped the unwary reader if such similar species would follow a species account rather than being sandwiched within it. Following best modern practice Sálim Ali has chosen the species as the unit of treatment rather than the subspecies. Field characters and ranges of the more distinct subspecies are however given. The nomenclature unfortunately is essentially the antiquated one of Stuart Baker. There is no reason why Indian ornithologists are waiting for a new Checklist of Indian Birds to be published at some future date instead of eliminating the useless generic names that now clutter up the literature. I noticed a few minor ornithological inaccuracies. The Short-billed Minivet of Stuart Baker is actually a conglomerate of two species (*brevirostris* and *ethologus*) which differ in ecology and distribution. The jungle Nightjar (*indicus*) occurs not only in the peninsular hills but also in the Himalayas (*hazarae* Whistler), as noted correctly on p. XXVII. *Caprimulgus monticola* (not *monticolus*) is conspecific with *C. affinis*. Black-headed and Rufous-backed Shrikes inter-breed at a broad front and must be considered conspecific (Dunajewski 1939). These are minor blemishes which do not detract from the value of this useful guide.

In an introductory section the distribution of 287 species in 13 regions of India is tabulated. This is followed by a quick key of the birds on the basis of prominent field-marks ('conspicuous tails,' 'prominent crests,' 'bright, largely blue,' etc.). With this practical guide even the beginner should be able to become quickly familiar with the birds of the hill country. The naturalists of India owe a debt of gratitude to Oxford University Press for publishing such a handsome volume at so low a price.

ERNST MAYR.

2. BOOK OF BAYS by William Beebe. Pp. 240, London. The Bodley Head Limited.

The author's name recalls memories of that exciting book *Half Mile Down* which we read many years ago, and this volume is also full of varied interest.

In the introduction the author says that the book is written 'of an unquenchable desire to know more of the lives—the homes, the food, the enemies, the mates—of certain wild creatures of sea and land.' This expedition which covered the Pacific Coast of South America afforded endless opportunities for studying and collecting the natural inhabitants of that extraordinarily interesting area. There are many items of information, which the author with his extensive biological background associates with relevant facts and theories.

Thirty years ago the island of Guadalupe was said to be a paradise of birds and plants. In the course of years, cats, rats and mice escaped ashore from ships, and somebody also turned loose a few goats. The goats now number 60-80,000 and every growing thing within reach has been eaten up. The cats

have eliminated the birds and the whole area is now desolate. The water at the island also appears to be insufficient and the goats were observed drinking salt water and also feeding on the exposed beds of kelp at low tide. This island was the last sanctuary of the sea-elephant and also at one time the northernmost limit of the Fur Seal, several hundred thousands having been slaughtered here. Some protection has now been afforded for both the seals and the sea elephants by the Mexican government and it is hoped that the remnants would survive. But the problem of animal preservation is not confined to India alone, there is reference to a whole colony of sea lions being exterminated very recently to make tinned meat for dogs.

As mentioned before the country is extraordinarily interesting and with the facilities at their disposal, the expedition have seen a great variety of incidents and specimens whose account sustains the interest of the narrative. Among the many items which make the book readable, two of particular interest to the naturalist in India might be mentioned:—

> The Iguana dives off mangroves in swamps into water with closely folded limbs as compared to their spread-eagling their limbs to the fullest extent when jumping from trees on to scrub. They feed entirely on young mangrove shoots and leaves. In some parts of India the monitor lizards are known to live under similar conditions but apart from the fact that they are mainly carnivorous we have very little information about their habits.
>
> Spider Monkeys, so peculiar to South America, when passing through trees in parties, follow one another and use the same holds for hands and feet as their predecessors—the route being fixed as a well-worn trail through thick undergrowth.

It all makes us realise how very much more we have still to learn of the natural history of the birds, mammals, reptiles and the invertebrates of India. Except for an occasional tendency towards polysyllabism and hyperbole, it is certainly the sort of book we would like to see more of.

H. A.

The following books have been added to the Society's Library since July 1949 :—

1. ANIMAL ENCYCLOPAEDIA—MAMMALS. By Leo George Wender (Allen & Unwin Ltd., London, 1948) (A Review copy).

2. MAMMALS OF EASTERN ASIA. By G. H. H. Tate (The Macmillan Company, 1947).

3. INDIAN HILL BIRDS. By Sálim Ali (Oxford University Press, 1949).

4. THE ANAMALLAIS. By C. R. T. Congreve (Associated Printers, 1949 ?).

5. THE FAMILIES & GENERA OF LIVING RODENTS Vol. III, Part I. By J. R Ellerman [British Museum, (Nat. Hist.), 1949].

6. HISTORY OF THE PRIMATES—AN INTRODUCTION TO THE STUDY OF FOSSIL MAN. By W. E. Le Gros Clark [British Museum, (Nat. Hist.), 1949].

MISCELLANEOUS NOTES

1.—PARIAH DOGS KILLING TIGER

It may be of some interest to members of the Society to hear of village pariah dogs attacking and killing a tiger cub. This incident occurred on the 23rd of April when a tigress killed two bullocks in a village (Bitkilsoya) near here. The village dogs were also interested in the carcases and it was whilst they were at the kill that the cub appeared and was promptly set upon and killed by the dogs. It was a cub of about three months of age. I have never before heard of village dogs attacking tiger or cubs on a kill.

P.O. JARAIKELA,
B.N. RLY., K. M. KIRKPATRICK
1st May, 1949.

2.—A TAME FOX

'Vixen' was a full-grown fox (of the Himalayan variety) when she came into my keeping, so I can take very little credit for her being so tame. I first saw her in the Lahore Zoo and straight away fell in love with her, and made up my mind to get her, somehow or the other. A few days later I was having tea with my chief, and to my horror discovered that he too wanted her. But one bright star rose in the horizon: his wife was all against his getting her, and begged of me to acquire her and take her to the jungles, my normal home. Again luck came to me one afternoon in the shape of my boss discussing the subject with the then curator of the Zoo, in my presence. 'What will you take for her?' he asked. 'Two horned owls' was the somewhat amazing reply. This had been decided in the Committee Meeting a couple of days previously, as, apparently, several people were after Vixen and it was decided to give her to anybody who would produce two horned owls. My boss grunted and walked off in high dudgeon, muttering something about 'might as well ask for two kangaroos at short notice' !! As soon as he got round the corner I asked if the offer held good for me. 'To anybody who provides the owls' and this was good enough. Within an hour I was driving down the canal bank with two rats in a wire cage and my hawking nets in the 'tum-tum' beside me, and at just after 6 p.m. I deposited the owls, and marched off, the proud possessor of Vixen. That was just about 50 years ago but Vixen's memory still remains almost as fresh as when I had her.

Next morning I returned to Wazirabad which was then my headquarters, and had many qualms as to how Vixen would be received by my six dogs. Two terriers, one beagle, two spaniels

and a Tibetan sheep-dog. They were, fortunately used to all kinds of pets which master acquired from time to time, and a stern 'NO' when hackles went up, or an aggressive eye was turned on the fox, had the desired result and the introduction went off much better than I had expected. I had many surprises on that first day. After breakfast the dogs, fox and I went for a walk, the latter, of course, on a chain and the first surprise came when I saw her following without the least trouble, and without a single pull on the chain. Somebody had broken her to the chain anyway. The next surprise was on the following day when I let her off her chain, as she showed no sign of running away, and the first thing she did was to make straight for one of the spaniels, roll on her back and squeal with pleasure and 'bonhommie'. The spaniel accepted the advance, wagged his tail and one by one they all came and smelt her, even the sheep-dog. An hour later she was flying across the open *maidan* with the dogs in full pursuit, dodging in and out among them and causing collisions which now and again ended in a free fight among a couple of the dogs, while the others continued their chase after Vixen. She had obviously lived her life among humans, and dogs, and had had a good home, for she showed not the slightest tendency to leave us and loved petting and being made much of. The first night I had tied her to a box in my bathroom, but seeing she was well behaved and obviously not in the least likely to run away, she was promoted to a little bed in the corner of my bed-room and my next surprise came when my early morning tea was brought. I woke to find she had left her bed and was comfortably coiled up at the foot of mine, and as the door opened a set of evil looking teeth came into prominence and with ears back she very distinctly told my bearer—'one step further and you are for it'. The bearer believed her and hung back with the tray, till I had Vixen securely by the collar and drawn up to the top of the bed. She had, however, done her job and now took no further notice of the man. This little drama was enacted every morning during the three years or so that Vixen was with me, and ended in her coming into my arms and biting my chin, ever so lightly, as an invitation to come outside and play. In the house she was cleanliness personified. I should have given anything to find out who her late master and mistress had been who had brought up this very delightful little animal so beautifully, with absolute confidence in man and dog, and no inherent fear of either. How was this engendered? Was she born and bred in captivity, of parents who had lived their lives with man? I cannot, otherwise conceive how this absolute trust in man and dog came into being, in the first generation of life with them. That she accepted me as a pal I can understand as I had known her for some months when she was in the Zoo, and never did I go there without spending 10 to 15 minutes with Vixen and a pocketful of titbits which she much appreciated. But she showed extremely little, if any, nervousness among the dogs nor was she at all alarmed when a stranger came up, as many did, to ask questions about her. My jackals of which I wrote in the August (1948) number of the

Journal, though equally tame, were always nervous among strangers and either ran away or bristled, when any dog came near, and here was this fox quite at home with my dogs from the first!

In those days I was young and inexperienced but even so it struck me as strange that this should be so, and I just could not understand it and soon gave up trying.

Since then I have kept as pets almost every kind of carnivore in India, and however tame they got they always showed some slight degree of nervousness among strangers. Next to Vixen, a wolf was the tamest and most confiding of all my pets, but unfortunately died when about 10 months old of distemper, or something very like it.

Well, in time, as the spring began to turn into summer I made for my beloved jungles in the S.E. corner of Kashmir (Bhadarwar) where we spent a happy eight months not a little of which was spent in the shady valleys of spruce and fir, or the lovely alpine pastures above the tree limit. Here Vixen showed me how the fox family accounted for voles. As soon as we came upon the little mounds of earth thrown up by the voles in making their tunnels, she began stalking from mound to mound, actually, I think, to find out which was the most freshly thrown up. This done she went off a couple of yards and sat down between it and the next one. She very obviously meant business so I would call my dogs back and we would sit down some 15 yards away to watch for the next move. It came in the most unexpected quarter. Not on top of the mound as I quite expected, but at least 2 to 3 feet short of it, and between it and the next, and here she would begin to dig furiously, working up towards the mound of earth. Sure enough, a little pounce forward and out would come the vole in her jaws to be eaten at leisure. How, when and where, did she learn this trick? From her late master or mistress, or was instinct playing its part? Anyway, it was definitely clever, for had she attacked the mound direct, the vole would have shot down its tunnel at the first sound of disturbance with little chance of being caught.

The dogs invariably watched with the utmost interest and never took their eyes off the fox from the time she sat down to the moment she pounced, but I doubt if any of them profited by the lesson!

The next surprise I got was a year later when walking along a road between two stages, I noticed my dogs showing signals of alarm. It was about 3 p.m. and I could not think what was worrying them, when Vixen suddenly came down the hill shouting her alarm call, almost in hysterics. *Pheaw, pheaw* rang the echoes from a line of cliffs in front. My dogs all came round me, the terriers with hackles stiff and just longing to be off to investigate, but the more sober spaniels and the sheep-dog with flags at half-mast, just terrified. The beagles seemed neutral but for choice would have joined the terriers. Vixen had nothing to do with their concerns but seemed to consider it her duty to let the countryside know, and not to forget, that His Majesty 'Spots' was on

the prowl and somewhere very near. Some villagers ultimately joined us and we moved on down the road, but it was a long time before Vixen quietened down.

I never thought much about it till the question of fox-dog cross came up in the *Journal,* but I cannot ever remember Vixen either enticing my dogs or being particularly attractive to them. The fact remains that in three years there was no mesalliance as far as I know, and certainly no family. It was towards the end of her third year we had a terrible tragedy while walking down the Mussoorie Mall one afternoon, between Landour and the Rink. The dogs were just ahead, there were dozens of people and rickshaws going up and down, and Vixen was just ahead of me and not five yards away, investigating some enthralling smell in the gutter. Suddenly from among the dahlia bushes above the road, a panther sprang down and had taken Vixen before she had even realised there was any danger from panthers. I shouted and threw my alpenstock at him, people on the Mall rushed forward shouting and my dogs turned and promptly gave chase, the two terriers disappearing down the khud not very far behind. That was the last I saw of the most delightful and lovable wild animal pet I have ever kept, who left a blank in my every walk, in the house, and wherever I was, which took a very long time to fill.

Fearn Lodge Hotel,
Ardgay, Ross-shire, C. H. DONALD, F.Z.S.
Scotland.

3.—A DISEASED GAUR

A bull bison was recently shot in these parts with all four hooves riddled with maggots. Presumably it had had foot-and-mouth disease in all feet. It was somewhat emaciated and could not travel far. It would probably have died within 3 or 4 months.

Honnametti Estate,
Attikan P.O. (Via Mysore), RANDOLPH C. MORRIS
6th May, 1949.

4.—CHARGE BY UNWOUNDED BISON

While returning from a morning stalk with a friend along a jungle-clad ridge on March 26th we came, round a corner, face to face with a solitary bull bison about 5 yards off. I was leading, and turned to my friend with the words 'look at this'. I noticed the bull had its head down and its eyes had a strange look. The next moment the bull was on us in a furious charge, as we leapt behind two trees. The impetus of its charge carried it straight over a small precipice bordering the path we were on

in the evergreen shola; and the bull rolled crashing down, making a clean sweep of all growth in its fall. Apparently uninjured the bull got to its feet and made off; leaving us mystified as to the reason for its extraordinary behaviour. I have never known an unwounded bull to charge. One possible reason for its aggressiveness is that it was undoubtedly irritated beyond endurance by a large tiger that spent its time trying to get a bison. Any old bison would have satisfied the tiger but although I counted 51 bison within a square mile (the only unburnt area for many miles around) the tiger never managed to bag one. When he wasn't stalking bison the latter were chivvying him with terrific snorts and bellows. We watched this interesting performance daily in the mornings. It was no wonder that everything up there got thoroughly peeved with and scared of everything else! In the area were milling around 28 elephants (of which we had previously taken movies and stills at close quarters); these had become fractious too; and made known their strong disapproval of the tiger's presence in their usual way. The herd bull smashed the shoulder of an inoffensive buffalo bait with its trunk. This however may possibly have been due to the fact that the bait was tied on a track used by elephants; and elephants loathe being obstructed by animals on their line of march.

HONNAMETTI ESTATE,
ATTIKAN P.O. (VIA MYSORE), RANDOLPH C. MORRIS
6th May, 1949.

5.—NATURALLY OCCURRING ALBINISM IN A SPECIMEN OF *RATTUS NORVEGICUS* BERKENHOUT.

A wild example of the common or 'Brown' Rat, *Rattus norvegicus*, Berkenhout, trapped in a tenement in the Colony of Hong Kong on 29th December, 1948, seems worthy of record on account of its very marked degree of albinism. The abnormal areas of the pelage are pure white and there is sharp demarcation between these and the other parts of the animal which exhibit the usual greyish brown colouration of the species. The pure white areas include the whole of the belly, a confluent squarish patch occupying half of the right flank, two smaller patches on the left flank, the tip of the tail, the fore feet and the left hind foot. (Right hind foot missing.) The specimen is a female and has the following measurements (in millimeters): head and body 168, tail 172, hind foot excluding claws) 39, ear 20.

There can be no reasonable doubt that this is an instance of naturally occurring albinism, since it is known that no tame albino rats are imported or kept in the Colony of Hong Kong. Whilst the occurrence of a specimen such as this in a wild state may not be very remarkable, this is the first one to have been seen by the writer out of many thousands which have passed through his hands.

This record is published by kind permission of the Hon. Chairman of the Urban Council, Hong Kong.

COLONY OF HONG KONG, J. D. ROMER, F.Z.S.,
11th July, 1949. *Govt. Rodent Control Officer.*

6.—HOW LONG DOES THE GIANT SQUIRREL (*RATUFA*) LIVE?

LONGEVITY IN RODENTS AND OTHER MAMMALS.

Some of your readers may be interested to know that our pet Indian Giant Squirrel (*Ratufa indica*) who answers to the name of Susie, is now well into her tenth year. We received her as a well-grown youngster in May 1940, so she must have belonged to the March -April batch of litters. She used to spend the hot weather in Ootacamund, until in 1944 she was taken to Lucknow and survived three hot weathers there and last year went up to the Kumaon Hills. Now she is back in the Nilgiris. Her coat is as glossy, her manners as lively, and I regret to say, her palate as discriminatory, as they ever were, and she shows no signs of incipient senility.

We should be interested to know what is the usual expectation of life among these animals, as she has already outlived all her known contemporaries.

WOODSIDE COTTAGE,
FERNHILL, NILGIRIS, P. S. SUNDARA RAJ
18th July, 1949.

[We have the instance of a male Malabar Giant Squirrel, said to have lived over sixteen years in the museum of the Bombay Natural History Society which died in March 1901.

Squirrels, along with other rodents such as marmots, beavers, porcupines and flying squirrels are reported on the authority of Major S. S. Flower, to have a specific longevity of 5 to 10 years and a potential longevity of 15 to 20 years. Dr. P. Chalmers Mitchell defines specific longevity as the expectation of life at birth of a normal individual of a species, influenced by factors such as constitution, accidents, enemies, diseases as well as its powers of evasion, protection and resistance. Potential longevity, on the other hand, is understood as the age which animals attain when placed in an environment relatively ideal, free from the hardships of their normal habitat, the difference between the two being a rough measure of the natural conditions under which a species lives. Metchnikoff (The Prolongation of Life: 1907) has shown that there is a correlation between duration of life and the relative capacity of the large intestines, animals with a capacious hind gut usually being shorter lived in proportion to their size than those

in which the hind gut is reduced. Rodents form an exception to this general rule, as they have a relatively large hind gut and are long lived. The comparatively high specific longevity of this group of animals may be associated with their remarkable power of adaptation to different environments.

The age at which an animal reaches sexual maturity is also supposed to have a correlation with its potential longevity, as in the case of whales for instance. Recent enquiries show that some of the largest whales enter their reproductive phase when only 2½ years old. There is nothing definitely known about the age of cetaceans, but Capt. R. W. Gray (Growth and Longevity of Whales: *Nature,* 1929) mentions instances of the Greenland or Arctic Right Whale, *Balaena mysticetus* living, on harpoon evidence, to ages of at least over 24 and over 37 years.

Major Flower, after his extensive studies on the duration of life in animals, believes that the potential length of life of most of the living animals of the world appears to be dependent on the duration of their teeth, while no relationship is noticeable between the periods of gestation and either specific or potential duration of life. It is also a matter of surprise that the life span of domesticated animals like the cat, dog and horse have neither increased nor decreased during the long period they have been under human control.—Eds.]

7.—THE BLUE-BEARDED BEE-EATER (*ALCEMEROPS ATHERTONI* JARD. & SELBY) ON THE NILGIRIS

In his most interesting and useful book *Indian Hill Birds* Mr. Sálim Ali says, under 'Distribution' of the Blue-bearded Bee-eater 'Nilgiris (?)'. I do not know why he doubts the occurrence of this bird on these hills. Davison obtained it several times some years ago and the British Museum has specimens (a male from Sigur Ghat dated 10 June 1867, and three from Kullar obtained in October and November of the same year) in its collection. More recently Lt.-Col. H. R. Baker secured one on the Sigur Ghat which is in the Whistler collection presented to the British Museum.

With regard to this bird's present day status on the Nilgiris my friend Mr. C. Primrose has sent me, at my request, an interesting note on it. He says: 'It is certainly not common and is confined to small areas between 5,500 and 2,500 feet. I have seen it many times on the Coonoor—Mettupalaiyam road, the Kotagiri—Mettupalaiyam road, the Sigur Ghat and the bridle-path between Kil-Kotagiri and Mettupalaiyam. On this estate (Marvuhulla) two pairs have been seen by me from December to July in 1948 and this year, between 5,500 and 4,500 feet. Last year one pair attempted to breed, but deserted the nest owing to coolies digging at it. The tunnel excavated this year was in the same road bank but about 150 yards from last year's one. As it was beyond the reach of the average cooly at least one young was successfully reared to maturity. I several times saw one nearly fully fledged young at the tunnel entrance which, on seeing me, went back out of

sight. The query against the Nilgiris in *Indian Hill Birds* may have been inserted by the author owing to his not having, personally, observed this bird whilst he was in these parts. If that is so, it is not very surprising as it only occurs in pairs or parties of three or four (probably parents and young) in certain favourite localities, quite small in area, leaving these for others at a different elevation, probably from the higher to the lower one, during certain times of the year. Therefore the keenest observer could easily fail to see these birds while on a visit of some months.

The Arab saying "never the time, the place and the loved one together" is applicable to this bird on these hills.'

KENILWORTH,
COONOOR, NILGIRIS,
20th August, 1949.

CHAS. M. INGLIS
F.Z.S., C.M.B.O.U.

8.—CHANGE IN HABITS OF THE CEYLON HAWK-CUCKOO (*HIEROCOCCYX VARIUS CICELIAE* PHILLIPS)

Until recently the Hawk-Cuckoo in Ceylon was considered to be solely a migrant from the mainland, arriving early in November, 'and makes its way at once to the hills, taking up its abode in considerable numbers in the forests of the main range' (Legge). As it was noticed, considerably after Legge's time, that it was sometimes heard in the South-West monsoon, it was also thought that some birds loitered.

As far as I am aware, there was no concrete evidence that this bird was a resident in Ceylon until Mr. R. West, of Rookwood Tea Estate, Hewaheta (altitude 5,500 feet), shot a fledgling on 22-4-1949. On January 26th, in the same year, I saw a pair copulating on a tea estate in the Agrapatana district, altitude about 5,700 feet. Since then quite a number of fledglings have been seen in various parts of the wet zone hills, from December to May, all with the Ceylon Babbler (*Turdoides striatus striatus*) as fosterer. So far none have been seen in the dry zone hills, where the cuckoo is much less frequent.

The belief that it was a migrant rested very largely on Layard's statement that he shot three specimens in the outskirts of Colombo, and the bird's habits were such that it appeared to leave the island with the other migrants.

Its tendency to move down from the higher altitudes when it has finished breeding, and with the onset of the South-West monsoon, must have been more marked in Legge's day, when it frequented much higher altitudes than it does now. Then it probably moved down to jungle at lower elevations, where its occasional out of season calling would not be remarked, but as it was not heard in the jungles around Nuwara Eliya (6,000 feet and upwards) and on the Horton Plains (7,200 feet and upwards) from May to November, it was naturally thought to have left the island.

Layard's three specimens, shot in the old Botanical Gardens, Colombo, were thought by Legge to be newly arrived migrants. Whether this was so, or whether they were wandering Ceylon Hawk-Cuckoos, it is impossible to say; but the fact remains, that except for these three specimens, there is no evidence whatsoever that *Hierococcyx varius* visits Ceylon.

That the Ceylon Hawk-Cuckoo wanders down to the foothills when not breeding, is evident, as I have seen an adult in August (also a juvenile in September) on a tea estate in the wet zone foothills, altitude about 700 feet, and occasionally seen and heard males in the same area later in the year. These birds were obviously on the move, and there was no sign of them staying to breed. As far as I know, it has never been recorded from the plains of Ceylon——unless Layard's mysterious three birds belonged to the island race.

Legge, in the 1870's, wrote of its distribution as follows: 'It is common about Nuwara Eliya, Kandapolla, and the "plains" lying between the Sanatorium and Totapella. On the Horton Plains themselves it is no less numerous. . .' He also says that Mr. Bligh wrote that it was not uncommon in the Haputale range, and that it was yearly to be found on the Harangolla patanas (about 4,000 feet altitude) in considerable numbers. These patanas are in Kotmalie.

From this one learns that it was a bird of forest and patana land, quite common from an altitude of about 4,000 feet up to the highest elevations. Nowadays it appears to be almost entirely a tea estate bird, between altitudes of about 3,000 feet and 6,000 feet, and has practically forsaken its old haunts around Nuwara Eliya and the Horton Plains, though by far the greater part of these forests are still virgin. One does still hear an occasional bird calling in these high altitude jungles, a veritable voice crying in the wilderness, but I think such birds are only wandering. The last time that I heard a breeding group in these areas was in 1922. I was camping with friends at Pattipola (altitude about 6,400 feet), and we often rode through the jungles beween Ambawela and the Horton Plains by the old bridle road, but we only came across this one group of Hawk-Cuckoos, near Ambawela, which were making themselves heard far and near.

Not only has this Hawk-Cuckoo changed its habitat, but it has presumably changed its fosterer too. In Kotmalie there is a chance that *Turdoides striatus striatus* may have been available as a fosterer, as I believe that there was a certain amount of cultivation there even in early times, and the Ceylon Babbler must have open or cultivated country for its habit. But, on the other hand, Legge says that this babbler was not found above 3,000 feet in the *wet* hills, in his time. Over the rest of the Cuckoo's range, which apparently consisted of patana forest there can only have been the Ceylon Rufous Babbler, *Turdoides rufescens,* available as a fosterer.

This bird is a rufous counterpart of *Turdoides striatus striatus*, with orange bill, legs and feet. It is entirely a jungle bird, and has retreated with the clearing of the forests. The eggs are

almost identical, both in size and colour, with those of *Turdoides striatus striatus*. It is common in the jungles of the Horton Plains, and in those round Nuwara Eliya, and is found down to sea level in the wet forests of the south-west corner of the island. It seems probable that the Hawk-Cuckoo used it as fosterer, as it must have been common in this cuckoo's old breeding haunts, as it still is today.

That the Ceylon Babbler moved slowly up the wet hills, in the wake of cultivation, is certain. I well remember my excitement, when, as a child in Dikoya (altitude 3,700 feet) I saw a large, pale brown bird in our garden, that I had never seen before. That must have been about 1910. In five years time the Ceylon Babbler was a common breeding bird in the Dikoya District, and is now found plentifully up to an altitude of nearly 6,000 feet in these wet hills. As it moved up, the Hawk-Cuckoo apparently moved down, adopting it as its fosterer instead, it would appear, of the more elusive Rufous Babbler, which is said to conceal its nests with great care.

Whether the Hawk-Cuckoo has increased or decreased owing to these changes of habitat and (presumably) fosterer, it is hard to say. I would not state, like Legge, that it is now found in 'considerable numbers' but, on the other hand, it is now spread over a larger tract of country.

118, Boxley Road,
Maidstone, Kent, England, CICELY LUSHINGTON
26th August, 1949.

9.—GREEN PIGEONS IN A SWAMP

May I add to the notes on the above subject by Messrs. Frend (April 1948, Vol. 47) and A. St. J. Macdonald (December 1948, Vol. 48, p. 184)? In the *Ibis* (1939) I recorded finding many hundreds of Grey-headed Imperial Pigeons (*Ducula badia griseicapilla*) at a salt lick in the Triangle and in other parts of the lower Kachin hills. I obtained both the Wedge-tailed Green Pigeon (*Sphenocercus sphenurus*) and the Pin-tailed (*apicauda*) at licks. The various plains species of green pigeon were also extremely numerous at salt licks in the Pidaung Game Sanctuary.

Stanton's Farm,
Kingsclere, Newbury, J. K. STANFORD
19th June, 1948.

10.—WOODCOCK OUT AT SEA

While on patrol in the Bay of Bengal on the 22nd October 1942 just after the Midnapore cyclone, a woodcock was seen flying round the ship at daybreak. After several abortive attempts to alight on the shrouds it eventually settled on deck in the shelter of the 4-inch gun mounting, on the forecastle.

The position of the ship when the bird came aboard was approximately 112 miles W.S.W. of Elephant Point which was the nearest land.

It remained on board in the same position all day in spite of the fact that owing to heavy weather sheets of spray were thrown over it. Though obviously exhausted it would neither drink water nor eat bread crumbs and some bully beef placed near it.

About 5 p.m. when Elephant Point (a few miles south of Cox's Bazar) was sighted, the bird flew off towards the coast.

The previous three days we had experienced very wild weather with high winds and heavy seas in one of the worst cyclones for many years, and presumably the bird must have been blown out to sea either from the Sunderbans or the Arakan Coast. It might have been from either as the wind was constantly changing direction.

c/o Grahams Trading Co. (India) Ltd.,
16, Bank Street, Bombay, A. E. G. BEST
4th August, 1949.

11.—OCCURRENCE OF THE WOODCOCK (*SCOLOPAX RUSTICOLA* L.) AT MOUNT ABU

While on holiday at Mount Abu on 2nd July this year I was surprised when R. K. Nirmalkumarsingji of Bhavnagar's shikari brought me a woodcock he had caught in a damp spot in the forest near the St. Mary's High School. The bird was caught in a net set for spur-fowl and other ground birds which this shikari was catching for my aviaries. I examined the bird at leisure and there can be no doubt about the identification. The weight of the bird was ten and a half ounces.

Jasdan, Y. S. SHIVRAJKUMAR
20th July, 1949.

12.—MERGANSERS FISHING

During a recent visit to Assam (March 1949), we camped for a few days in beautiful surroundings on the banks of the Manas River, where it emerges from the Bhutan Hills, into the North Kamrup Game Sanctuary. Though one is hardly 300 feet up here, the river is icy cold, and several Himalayan birds which one usually associates with higher elevations were seen. Among them were Ibis-bills (a party of nine was seen at one time), Himalayan Pied Kingfishers, White-capped Redstarts and Mergansers.

Stuart Baker in the Fauna (Vol. VI, 473) says 'the Mergansers are most interesting birds to watch, as they either swim upstream

singly against the not inconsiderable current, or work in parties of six to eight birds across the stream from shore to shore'.

When the birds were in parties on the Manas, we often noticed a similar number of Little Egrets in attendance. As the mergansers approached the shore, the egrets would fly over them and take up advance positions in the shallow water, the fish being hemmed in between the egrets and the mergansers. As the mergansers closed in, there was a lot of excitement and rushing about, and both parties appeared to catch quite a few fish. In the last stages, some mergansers darted forward over the surface of the water in inexplicable spurts as if jet-propelled. A black-bellied tern occasionally took up a fish between the two parties. The mergansers would then turn round and work back across the stream, the process being repeated by the egrets. The birds all seemed to work in a very amicable and co-operative manner.

c/o Faiz & Co.,
75, Abdul Rehman Street, HUMAYUN ABDULALI
Bombay,
15th April, 1949.

13.—BIRD MIGRATION IN INDIA

Since the publication of records of recoveries of ringed birds in or from India (Vol. 47, pp. 690-99) the following information has been received from the Bird Banding Bureau, Moscow to complete the four blanks under the 'Date' and 'Place where ringed' columns on page 698.

No. of Ring	*Date*	*Place where ringed*
81029 E (Moskwa)	12–8–1941	Astrakhan
68993 D (Moskwa)	25–7–1939	Astrakhan
60276 D (Moskwa)	4–8–1937	Lake Teten, Eastern Kazahstan (Not *A. acuta* as reported by recoverer, but *A. strepera*).
54294 E	4–8–1937	near Semipalatinsk, E. Kazahstan.

114, Apollo Street,
Fort, Bombay, EDITORS
15th May, 1949.

14.—FIELD IDENTIFICATION OF BIRDS

In the study of birds in India, we have now reached a stage when extensive field observations are almost as important, if not more so as collections of skins, and it might be profitable to draw the attention of all students to the necessity of scrupulous carefulness in their recordings. The following extract from Peter Scott's 'Wild Chorus' (Country Life Ltd., London, 1938) will serve to remind observers of their responsibility:—

> '"Now *you'll* be able to tell me" they always begin. "The other day I saw a big bird. What would it have been? It had a white head and a black breast."
>
> "Of course", I reply, "it might have been a Shelduck, only that has a black head and a white breast."
>
> "Well, now I come to think of it, that's just what this bird did have."
>
> There can be further developments on the theme. "I'll tell you what, thought", say I, "didn't it have rather a turned up beak?" "That's right." "Well, I believe it was almost sure to have been an avocet, which is a very rare bird. How interesting!"
>
> I have to be very brazen about this, because by this time I have little doubt that the bird in question was in fact none other than a magpie.
>
> But sometimes the mystery bird is not so easy to identify. The most bewildering are those which are described by a reliable observer and which do not fit in with any known bird. I am left wondering whether my informant was mistaken or whether he has in truth discovered a species new to science.'

As regards the claim made by some persons to be able to differentiate between confusing subspecies of birds in the field, Col. R. Meinertzhagen (*Ibis*, 1943, p. 349) wrote:—

> 'My experience of sight records is that they lead to gross errors. I have placed a bullet in a tree-trunk thinking it was a giraffe; I have also shot a "hyaena" and picked up a lion; I have seen Whooper Swans in a mirage which gave the hallucinatory semblance of Pelicans complete with pouches; I have seen Sheld-duck in glare which would have been recorded as avocet if they had not been seen later in shade; I have seen a reputable British ornithologist pointing out a soaring Buzzard as a Sea-Eagle to a party of gaping German ornithologists, and I have seen two batteries of anti-aircraft guns firing at 15,000 feet at an Egyptian Vulture at 5,000 feet, thinking it was an enemy aircraft.'

A good many puzzling and even improbable records have found their way into ornithological literature in this manner; and once in print such records can seldom be effectively correctd or eradicated.

While therefore it is gratifying to notice the swelling ranks of bird watchers in India within recent years, it is hoped that side

by side with increasing interest there will also grow a proper appreciation of the difficulties and drawbacks inherent in all sight records of birds, and of the importance of correct identification for notes to be of the fullest scientific value.

114, Apollo Street,
Fort, Bombay, EDITORS
10th *July*, 1949.

15.—PRESERVATION OF WILD LIFE

Lt.-Col. Burton is to be congratulated for the missionary zeal with which he has championed the cause of wild life in India. Forest Officers who spend the best part of their lives in jungles get to know and love their animal associates to the extent of being jealous of sportsmen. The credit for whatever protection was afforded to our wild life in the past goes to the lone forest officer who among his multifarious duties found time to enforce the game laws and apprehend poachers. In the United Provinces, it was at the intitiative of the Forest Department that the first National Park in India was constituted. This year, I succeeded in creating the Rajaji Sanctuary in the Siwaliks, which comprises shooting blocks once reserved for the Governor-General. Not unoften a Divisional Forest Officer would initiate special closure for deer after a severe rinderpest had taken its toll and decimated their number. In the Saharanpur Siwaliks, I used to arrange special watering facilities for our animals. Champion's photographic studies of wild life are known the world over.

2. Far be it from me to belittle the part played by eminent sportsmen like Col. Burton in rivetting the attention of the public to the need of preserving wild life. Officers of the civil and military services have rendered yeoman service to this noble cause.

3. While agreeing with much that Lt.-Col. Burton has said in his valuable pamphlet on 'Preservation of Wild Life'[1] and in the supplement issued later, I cannot reconcile myself with the view expressed by him that the interests of wild life come in such sharp conflict with forestry, that forest officers cannot be entrusted with the task of looking after animals, a task which they have performed so well for the best part of a century. Theirs has been a labour of love. I do not deny our shortcomings, but I do feel that the contribution of several generations of forest officers towards the preservation of wild life deserves better appreciation.

4. I must confess, I see the advantages of organising a separate Wild Life Department, the best justification for it being its ability to cover vast areas outside the reserved forests. In the early stages, however, the balance of advantage would lie in enlisting

[1] Reproduced in the *Journal of the Bombay Natural History Society*, August 1948.

both the services and the co-operation of forest officers in the stupendous task of preserving wild life. True, forest officers are not conversant with the modern technique adopted in the preservation, control and protection of wild life. But, what I submit for the consideration of enthusiasts like Lt.-Col. Burton in that after all said and done, an average forest officer knows far more about wild life than an average civilian or an agriculturist or even a sportsman. One wonders where the game wardens and upper grade assistants will come to be recruited from in Burton's scheme. In no other walk of life is even a nodding acquaintance with the animal kingdom available except in the forestry profession.

5. There is at present neither need nor room for organising a separate Wild Life Department. Might I urge that the solution of the problem lies in the adoption of a middle course? The cadre of the Forest Department should be supplemented to enable it to organise wild life preservation on modern lines. What is needed is not the creation of a separate department consisting of a large number of whole-time officers, a host of clerks, menials, orderlies and other paraphernalia, but the appointment of regional wild life officers working in close collaboration with the existing Forest Departments and their vast organisation for surveying, mapping, policing and maintenance of roads and resthouses.

6. The sort of organisation which I envisage for the United Provinces is as under :—

(i) Provincial board for the preservation of wild life.

The board will consist of the following members :—

(1) Honorable Minister in charge of the forests or his Parliamentary Secretary (*Chairman*)	1
(2) A member from each of the 2 houses of legislature	2
(3) Enthusiasts from sporting circles	2
(4) Chief Conservator of Forests	1
(5) Director of Agriculture	1
(6) Director of Veterinary Services	1
(7) A senior Commissioner	1
(8) Provincial Wild Life Officer (*Secretary*)	1

The functions of this board should be advisory. It will be a sort of standing committee to advise Government in respect of legislation to be enacted for the preservation of wild life. The board will direct its secretary to devise ways and means to enforce existing game laws to afford facilities for tourists and to secure protection from and for wild life. The board will meet twice a year.

(ii) The Provincial Wild Life Officer will be recruited from among (1) experienced forest officers noted for their studies of wild life and (2) eminent sportsmen. There will be no age-limit. He will have two regional officers to assist him who will be styled as game wardens. Each game warden will have 2 field assistants.

(iii) Offices. The Provincial Wild Life Officer will be attached to the Chief Conservator but will have an office of his own. Regional

game wardens will utilise the divisional office organisation and will be attached to specific divisions in which sanctuaries are situated.

(iv) Menials. Each Wild Life Officer will have *shikari* orderlies.

7. The budget provision for the above organisation will be somewhat as under:—

	Scale of pay	*Average annual pay*
	Rs.	Rs.
(1) Administrative and executive staff—		
Wild Life Officer 1 ...	500–50–1,200	11,351
Game Wardens 2 ...	250–25–400–EB–30–700–EB–50–850	14,208
Field assistants 4 ...	75–5–120	5,224
Total ...		30,783
(2) Clerical establishment—		
Senior Clerk 1 ...	80–5–100–6–130	1,411
Typist 1 ...	60–3–90–4–110	1,080
Junior Clerk 1 ...	60–3–90–4–110	1,080
Draftsman 1 ...	50–4–90–5–125	1,264
Total ...		4,835
(3) Menials—		
Shikari orderlies 6 ...	25–½–30	2,064
(4) Travelling allowance including that of members of the board.		12,500
(5) Contingencies, photographs, etc....		4,818
Total ...		55,000

8. All expenditure incurred on the preservation of wild life should be debited to a separate budget head. Similarly, all revenue from

(1) Shooting and fishing fees,
(2) Fines for breaches of shooting rules,
(3) Sale of horns, hides tusks and other trophies,
(4) Sale of animal photographs,
(5) Fees charged from sportsmen for the occupation of resthouses.

should be credited to a separate head of revenue.

9. Associations organised in the past for the preservation of wild life have seldom functioned. The Association for the preservation of Game in the United Provinces is virtually a defunct body. The Forest Department has contributed a sum of Rs. 1,200 per

annum as a grant-in-aid for many years to this Association. This year, I have not been able to contact the Secretary, despite many reminders and no one is forthcoming to take the grant sanctioned by Government.

10. Here is an inexpensive organisation which is likely to be self-supporting in due course. It has a fair chance of being accepted by Provincial Governments without much ado. Anything more elaborate, I am afraid, would remain an idle dream.

NAINI TAL, U.P.
8th *February*, 1949.

M. D. CHATURVEDI
B.SC. (OXEN), I.F.S.,
Chief Conservator of Forests,
United Provinces.

[Lieut.-Col. Burton comments on the above as follows:—

'This constructive note is the first communication regarding my pamphlet received by the Society, or by me, from any officer of the Indian Forest Service. As such it is very welcome; also because criticism by an experienced officer of the Forest Department has much value.

Mr. Chaturvedi appears to have overlooked the handsome and well deserved tribute expressed in paragraph 8 of the supplement (published antea pp. 290-99) to the many officers of the Imperial Forest Service who, throughout their service, worked continually and persistently to enforce wild life protection and the laws and rules in regard to it, and to have them perfected.

In paragraph 4 of his note the Chief Conservator sees the advantages of organising a Wild Life Department. In the next paragraph he says here is neither need nor room for organising a separate Wild Life Department, and advocates a middle course which he outlines in some detail.

In other countries it has been found that half measures are futile and waste of time; and that there is in fact no satisfactory middle course.

The Chief Conservator wonders where the wardens and upper grade assistants will come from. Surely it can be envisaged that the bulk of them will be obtained from among those of the Forest Service who have at heart, as has the C.C.F., the interests of the wild animals and birds they have seen daily in the forests through the years of their service. Recruitment of staff would be through careful selection of applicants in all grades.

All things have a beginning. Perhaps the scheme drawn up for the United Provinces by the Chief Conservator will herald the commencement of the much needed all-India policy envisaged in Section D of the proceedings of the Conference held at Delhi on the 6th September 1948 to secure the implementation of a co-ordinated forest policy dealing with inter-Provincial and national matters.

There is no matter more wholly national than the effective protection and preservation of that Wild Life which is the Vanishing Asset of the peoples of this country.—EDS.]

16.—WHAT ARE THE CAUSES OF THE DISAPPEARANCE OR REDUCTION OF FAUNA SPECIES FROM CERTAIN AREAS?

While it is recognised that poaching (cum wild dogs) are probably responsible for the extinction of the nilgai (blue bull) over most of South India; and of black buck and chinkara over wide areas, this cannot account for the very remarkable diminution of the chausingha (four-horned antelope), and the ubiquitous jungle sheep (barking deer) from areas in which they were very numerous only a few years back. Poachers rarely waste valuable powder and shot on such small creatures. Nor can the decrease be solely attributed to wild dogs. The barking deer (jungle sheep) is now rarely seen or heard in the North Coimbatore and Kollegal Forest Divisions, and the adjoining Mysore State jungles; and yet they were very common up to 7 or 8 years ago.

What caused the disappearance of the Cheetah or Hunting Leopard from South India—indeed over India as a whole?

The Jackal suddenly disappeared from that part of the plateau lying at an elevation of 3,000 feet east of the Billigirirangan Hills (Coimbatore District) some 15 years ago, and has never returned, although it still occurs further to the east at a lower elevation (2,000 feet).

Hyaena are now rare in the same 3,000 feet area. Panther, which up to 4 years ago were numerous in the forest divisions referred to above are now seldom seen or heard of. The decrease of barking deer, etc., may have something to do with this. Pig, once very numerous in the same jungle, are equally rare now.

Up to 5 or 6 years ago the low country scrub jungle (elevation 1,000 feet to 3,000 feet) to the east and west of the Billigirirangans and the Bargur Hills teemed with jungle fowl, grey partridge, peafowl, quail, and spurfowl. Few, in comparison, are seen nowadays—but this may be due to the poultry disease (known as Ranikhet disease) having become endemic in the jungles, as it is in the villages they surround.

We are still a long way from understanding the reasons for the migrations, temporary or permanent, of animal species. First mange and later rabies caused wild dogs to disappear from these areas for about a year each time, before and during the last war; and no doubt some kind of scourge is generally the cause of temporary extermination of game. But the reasons for the permanent extinction or diminution of species that are not poached is far less easy to understand. In none of the cases referred to can it be said that their food supplies have been affected.

What then is the answer? Our knowledge of animal ecology must be far more profound than at present if we are ever to introduce effective measures for conservation.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE (S. INDIA),
10*th May*, 1949.

RANDOLPH C. MORRIS

17.—FREAK SHOTS

Your invitation under this head in the *Journal,* Vol. 48. (i) is bound to prove of general interest.

I give below a few incidents that have come within my experience.

Snipe.

Some years ago the *Field* published a series of articles or letters by contributors which started, by one person claiming to have killed all the birds in a small wisp in one shot, numbering four. This was beaten by another with six, and so on until it reached 9. I met a man, a well-known sportsman, being pig-sticker, angler, and both big and small game shot well above average, who had actually shot eleven, but he would not submit it to the *Field* ! !

Junglefowl.

While shooting driven murgi in the Gorakhpore District of the U.P. one X'mas camp, I had the strange experience of shooting the head and part of the neck off three birds on the same day in a bag of forty odd.

It was close-in shooting in cane and tree cover, with birds passing at close range, and may happen at any time under these conditions, but three times in the same day is freak. My host and two other guests witnessed it.

Duck.

This again is another man's story, but I have been out with him often, and can vouch for its authenticity. The hero of the act was at all times extremely dangerous with his hammer gun frequently carried at full cock and at the trail, ready to warm up the pants of those venturing to walk in front of him in file.

The incident took place in one of the many U.P. tanks with raised banks, covered in grass and bushes and affording cover to the water edge. Some hundred or more pintail duck were seated on the tank, and the shikari crawled through, with the gunman close on his heels and at full cock as usual crawling on hands and knees. As they approached over the crest of the bank and worked down to the water's edge, the shikari had by some act of providence moved to one side when both barrels went off, the triggers being fouled by some obstruction. He picked up seventeen dead and fluttering pintail. 'Was that not lucky?' is all he had to say ! ! !

Chakor.

This, though not a freak shot is a freak pick up !

I was shooting the hill face overlooking Bhim Tal behind the dak bungalow with the beaters spread out on the face above me, but had failed to connect with any of the three small coveys known to be there. I had just watered my dogs at a spring when a shout went up, and a single bird—the only one we had seen that day, came

sailing over me, but I clicked two empty barrels as he passed by, and before settling in a heap of boulders half an acre in extent. Determined to get this bird I first worked it with the dogs, and when nothing came out, called the beaters down, but before they arrived my Labrador came round the corner with the chakor in his mouth, alive and fluttering. In my shooting diary I have entered: 'Only one chakor today, and that was caught by "Boy". Aktar the shikari thinks he is the best dog that has ever been up here.'

Mixed Bag.

I have shot a quail and Luggar Falcon in the same shot. I shot at the quail and the falcon arrived as they usually do, with incredible speed from the sky just as I fired, and both dropped about five yards from each other.

A tiger and an old solitary boar with a right ant left in the C.P. was another unusual mixture.

CALCUTTA, A. ST. J. MACDONALD

15th June, 1949.

18.—GLEANINGS

The 'thorn' or 'claw' in panthers' tails.

With reference to Mr. Boswell's note in the *Journal*, Vol. 47, p. 716, it might be interesting to note that G. C. Shortridge in 'Mammals of S.W. Africa', p. 85, writes:

> 'The so-called claw at the end of a lion's tail is usually no more than a small horny scale attached to the skin at the tip of the last vertebra. There are better-developed terminal 'claws' on the tails of the Nail-tailed Wallabies—*Onychogale* and on the Marsupial Rabbit—*Thallacomys lagotis*, that of the latter being pointed, slightly curved and not unlike the sting of a scorpion.'

Bat Migration.

> 'In the city of Chengtu (W. China) I am astonished at the multitude of small bats I see every evening flying south (September 1869), as if these little mammals were also on a voyage of migration towards Southern regions' (Pere David's Diary, Fox's translation p. 298).

Hibernation of Nightjars.

> On p. 45 of volume 50 of the 'Condor' there was a note by Edmund C. Jaeger recording the finding of an American Nightjar (*Phalaenoptilus nuttallii*) in a state of torpidity in a niche in a rock in the cold weather. This was handled for some time but then flew away.

In the May/June issue, volume 51, pp. 105 to 109, there is an extraordinary account of the same bird found in the identical place on 26th November 1947. After this, the place was visited every week until 22nd February 1948 (85 days) on which occasion it flew away on handling. Rectal temperatures were recorded and varied between 18.0 and 19.8 C, while the air temperature was between 17.5 and 24.1 C. During all this period the bird was presumably in a dormant condition. There is a photograph of the bird lying on a man's hand with its head laid across its back and apparently fast asleep.

On 24th November 1948, the bird was back again in a similarly dormant condition but disappeared on the 19th December apparently having been disturbed.

19.—'AGGRESSIVE DEMONSTRATION BY RUSSELL'S VIPER'

I admire the way in which Mr. V. M. Vasu in Vol. 48 No. 1 of the *Journal* corroborates Mr. A. A. A. Fyzee's note in Vol. 47 No. 2 at pp. 388-89; and by giving an emphatic statement of his personal experience with a Russell's Viper (*Vipera russelli*) near Navibunder on the west coast of Kathiawar (Saurashtra). I confess that I am not an expert on snakes apart from the fact that my Arab watchman used to present me with an odd hundred snakes killed by him during the year from my garden compound in Bhavnagar, which I tried to identify to the best of my ability; amongst these at no time do I recollect having seen a Russell's Viper. In fact I have not heard of, or seen a Russell's Viper in any part of Kathiawar although it *may* occur somewhere. My recent visit to the Navibunder area, at the mouth of the Bhadar River, made me feel that that would hardly be the proper place to harbour a Russell's Viper, however small it may be, on account of its almost barren and semi-desert terrain. I am, myself, inclined to believe that what Mr. Vasu saw, must have been the Common Saw-scaled Viper (*Echis carinata*) which gives out a hissing, or in my own words, a fizzing sort of sound, created by the friction of the scales rubbing on each other, when disturbed. However, I am now very much interested to know whether any reader or person has any authentic record of Russell's Viper (*Vipera russelli*) in Kathiawar (Saurashtra) and if so, from where.

BHAVNAGAR,
SAURASHTRA, K. S. DHARMAKUMARSINHJI
2nd June, 1949.

[We have failed to trace any specimens or authentic records of Russell's Viper occurring in Kathiawar; therefore it is possible that, as suggested above, Mr. Vasu may have confused its identity with *Echis* which is common in that area.—EDS.]

20.—A NEW SPECIES OF PIT VIPER FROM SOUTH INDIA: *TRIMERESURUS HUTTONI* SP. NOV.

Description of the type. Snout sharp, distinctly upturned, its edge continuous with the equally sharp canthus rostralis. Upper head scales unequal subimbricate, some of them obtusely keeled, 10 or 11 in a line between the supraoculars; these are narrow and entire but have their inner margins indented by the adjacent scales; internasals not twice as large as the adjacent scales, separated from one another by two small scales; supralabials, the first entirely separated from the nasal, the third much larger than the others; temporals strongly keeled.

Scales in 21: 23: 19 rows, indistinctly keeled on the posterior part of the body. Ventrals 146; anal entire; subcaudals 52 pairs.

Colour Green above, paler on the sides, with a distinct series of dorso-lateral, paired, small, white spots; pale green below; a white temporal streak, edge with red below; it is continued forwards in front of the eye; tip of snout and end of tail dull red.

Total length 138, tail 40 mm.

The paratype agrees well with the type. It has a single scale between the internasals; there are 8 scales in line between the supraoculars, ventrals 139 subcauds 49. Total length 139, tail 41 mm.

The sharp upturned snout of this new species of viper gives it a resemblance to the Malayan *T. borneonsis;* in general scalation, except for the separation of the first labial from the nasal, it is related to *T. erythrurus.*

Trimeresurus huttoni is described from two juveniles, both evidently belonging to the same brood. They were captured together in the High Wavy Mountains, Madura District, South India; altitude 5,200 feet, by Mr. Angus F. Hutton, after whom I have much pleasure in naming it.

The type has been presented to the British Museum (Natural History), and the paratype has been retained by Mr. Hutton for his own collection.

British Museum (Natural History),
South Kensington,
London, MALCOLM A. SMITH
2nd April, 1949.

21.—NOTES ON A SECOND SPECIMEN OF THE SKINK *DASIA SUBCAERULEA* FROM SOUTHERN INDIA

Dasia subcaerulea has until now been known from a single specimen caught at Bodinaikkanur (Madura District) altitude 1,100 feet, and described by Mr. G. A. Boulenger in 1891. Mr. Hutton has now obtained a second specimen from the High Wavy Mountains, altitude 5,900 feet, and about 10 miles S. E. of Bodinaikkanur.

Except that the pre-anal scales are not enlarged, it agrees well with the description of the type, so that the resemblance of

this species in scalation to the Indo-Chinese-Malayan *D. olivacea* is more complete than before.

In general colouration it also agrees, except that the two black sreaks upon the neck of *subcaerulea* are never present in *olivacea*.

The digits of the type of *subcaerulea* are shrivelled as I have stated in my description (Fauna Brit. India, p. 278). This is due to desiccation.

The digits of this second specimen are also unfortunately damaged, the result of being burnt. It was caught on the ground after a forest fire. Those sub-digital lamellae, however that are still undamaged, are enlarged basally, and suggest that this species like its ally has aboreal habits.

When caught Mr. Hutton's specimen was light greenish-yellow in colour above with black and white spots as in the type. This colouration has now disappeared, and the specimen is dark brown above, so dark that the spots are hardly visible. The appearance is of a specimen that at some time has been placed in formalin.

It is considerably larger than the type having a length of 70 mm. from snout to vent; most of the tail is missing.

This specimen has also been presented to the British Museum (Natural History).

British Museum (Natural History)
South Kensington, MALCOLM A. SMITH
London,
3rd March, 1949.

22.—EGG-LAYING BY THE INDIAN PYTHON IN CAPTIVITY

The December (1947) number of the *Journal* has a note by me on the breeding of the Indian Python. That note records that on 9 June 1947 a pet python of mine laid sixteen eggs; no male python had been (and has been) in the cage since 28 March 1938. Further information:—

On 6 June 1948 the same python laid twenty eggs, thirteen of them being of normal size and colour. These were 8½ inches measured round the centre, and 10½ inches round the ends.

On 5 June 1949 the same python laid eighteen eggs, twelve of them being of normal size and colour. These were 8½ inches measured round the centre, and 10 inches round the ends.

The eggs that were not normal were only about half the size of the others, hard, discoloured, dirty brown and sausage-shaped.

Loyola College,
Madras, C. LEIGH, S.J.
6th June, 1949.

23.—A POSSIBLE CAUSE OF BLANK DAYS WHEN MAHSEER FISHING

There is still much to be learnt about the classification and distribution of Mahseer and Bokar (Catli) in India. Also about the habits of these fish. But a very pressing question, of interest to sportsmen and scientists alike, is the still apparently unsolved problem of what is the cause of blank days at fishing, when the conditions appear to be good. Blank days, euphemistically styled by anglers as the 'glorious uncertainty' of fishing, and dismissed by others as a futile waste of time, frequently occur when all the accepted conditions of mahseer fishing are favourable. On these occasions, as every fisherman knows only too well, fish just won't bite.

In Assam I have often found that there are certain days when mahseer and bokar cannot be caught, in spite of several baits being tried. Sometimes they don't move at all. Other times they can be seen following the spoon, only following. Rarely they follow too close, and become foul-hooked. Then perhaps a red-letter day, and fish take well, almost any kind of bait. The conditions of these two types of day appeared to be the same. Why then the difference?

Most anglers in India agree that the following conditions are required for a good day's fishing:—

(1) Clear sky, free of rain and thunder.
(2) Clear water, not coloured.
(3) River not too low.
(4) Temperature not too low.
(5) No wind.
(6) Moon not full. (Opinion not unanimous on this point.)

About thunder, Mr. Macdonald himself seems (in his book 'Circumventing the Mahseer') to find the result variable on thundery days. But his contributor on fishing in the Darrang District of Assam, who is a very experienced angler, says of thunder '. . . good fishing may be had, provided there is no thunder about which seems to send the fish clean off the feed'.

With regard to muddy or coloured water, four out of five anglers seem to be of the opinion that it is useless fishing fly, fly-spoon or spoon when the water is not reasonably clear.

Concerning the moon, Mr. Macdonald does not appear to refer to this factor in his book. But Mr. Conway in his 'Sunlit Waters', I think, was very emphatic about mahseer never taking when the moon is full.

My own theory, not yet proved (but I have hopes), is that presuming the other main factors of the weather and water are favourable, fish go off the feed when the barometer is falling, or is low, and that they come on the feed when the glass is rising. And that they take particularly well *when the glass has been low and starts to rise*. This latter condition would explain the 'mad half hour' often experienced in Britain after (or even during) heavy rain, before a flood comes down. For during a storm, even a thunderstorm, the glass frequently starts to rise,

indicating the fine weather about to come. Similarly, when it is gloriously fine to all appearances, the glass may be gradually and slightly falling, foretelling wet weather in the near or distant future.

With this theory in mind, I have equipped myself with an altitude barometer, pocket size. I have not yet had time to study this while actually fishing, but during the last few months I have noticed that its rising and falling has no distinct relation to the actual weather at the time, but of course relates to the weather of three or four (or even more) hours ahead. In future while fishing, therefore, if the day is blank I shall refer to the barometer. If it is falling, I shall probably (being a keen angler) persevere just to prove my theory, but will perhaps be fishless. If, on the other hand, I find that the glass is rising, or high and remaining high, then I shall know that the fault is mine and not the fish's, and that I must find a better place or change my tactics.

On Sunday July 10th 1949 I went to a small forest stream nearby, to collect orchids. In case the water might have cleared sufficiently, I took a fly rod, but unfortunately left the pocket barometer at home. It may interest anglers to know that although the water was muddy and visibility only about one foot, I had a very pleasant two hours' fishing, killing 8 mahseer between 1 lb. and 3 lb. on a Hardy's 1 inch fly spoon. It was twice broken by larger fish, as my gut cast was an old one. The mahseer (no bokar were caught) were taking best of all in the middle of the severe thunderstorm which occurred, when the thunder claps were at their loudest (there was no rain). And when I returned to the bungalow, I checked up on my calendar—and it was the day of the full moon. So what? I believe that had I had my barometer with me, I would have noticed the glass rising after being low.

It would be interesting to hear the views of other anglers on the subject. It is said that when the glass is low, the oxygen of the water is diminished, making fish listless. Possibly this atmospheric pressure theory, which I believe is held by others in various parts of the world, may provide the solution of the problem of blank days, and save fishermen a lot of time and wasted energy.

DOYANG T. E.,
OATING P.O., E. P. GEE
ASSAM.

[Mr. A. St. J. Macdonald comments on the above as follows:

'Mr. Gee's note is a worthy contribution to the angler's quandary! It is only by such observation and experiment that progress is made.

The approach is scientific, so "We cry unto thee oh Pundits, Norman, Hora and Arthur Thompson."

The seasons and elements dictate the laws of Nature: breeding of beasts and birds, germination of seed, and hatching out of insects, in productive continuity; so why not fish?

I am inclined to agree that elemental influence plays a large part in a fish's life, whether feeding or migrating. But whether it be from a lack of (or too much) oxygen; pressure, as Mr. Gee now suggests; or some other indication that fish read in changed conditions in the water or weather, it is closely associated with insect life. We may go a step further into the entomologist's camp! What are the factors that influence the hatching out of beetles and of moths, to take just two? Fish seem to know when to expect them, and will immediately come on the feed with the first arrivals flopping in the water.

I have experienced this so often in the Kumaon lakes, where the surface was dead for most of the day with no fish moving, but the moment the first cockchafer beetle flopped in the water, the surface was alive with feeding fish. This also occurred at other times with white moth, and a large variety of may-fly found up there. Is this also a barometer problem?

On the influence of the moon I have already addressed a letter to the *Journal*, with graphs to illustrate results within my own experience.'

* * * * *

Dr. M. Suter, the well-known angler, writes:

'Mr. E. P. Gee's note touches on a subject which has puzzled most of us fishermen and has left me so after very many years of regular fishing within a radius of 100 miles around Poona.

On the whole I agree to the reliability of conditions 1, 3 and 4 of Mr. Gee's list, but as to condition 2 (clear water, not coloured) I have consistently done better in moderately coloured water than in crystal clear, in which latter fish seem to be more shy and wary of accepting an artificial lure.

Local Indian fishermen, spinning a bunch of green algae or a hook tied between two triangular slices of white coconut flesh in rapid runs catch every year fish up to 25 lb. and over when rivers are in spate and the water quite muddy.

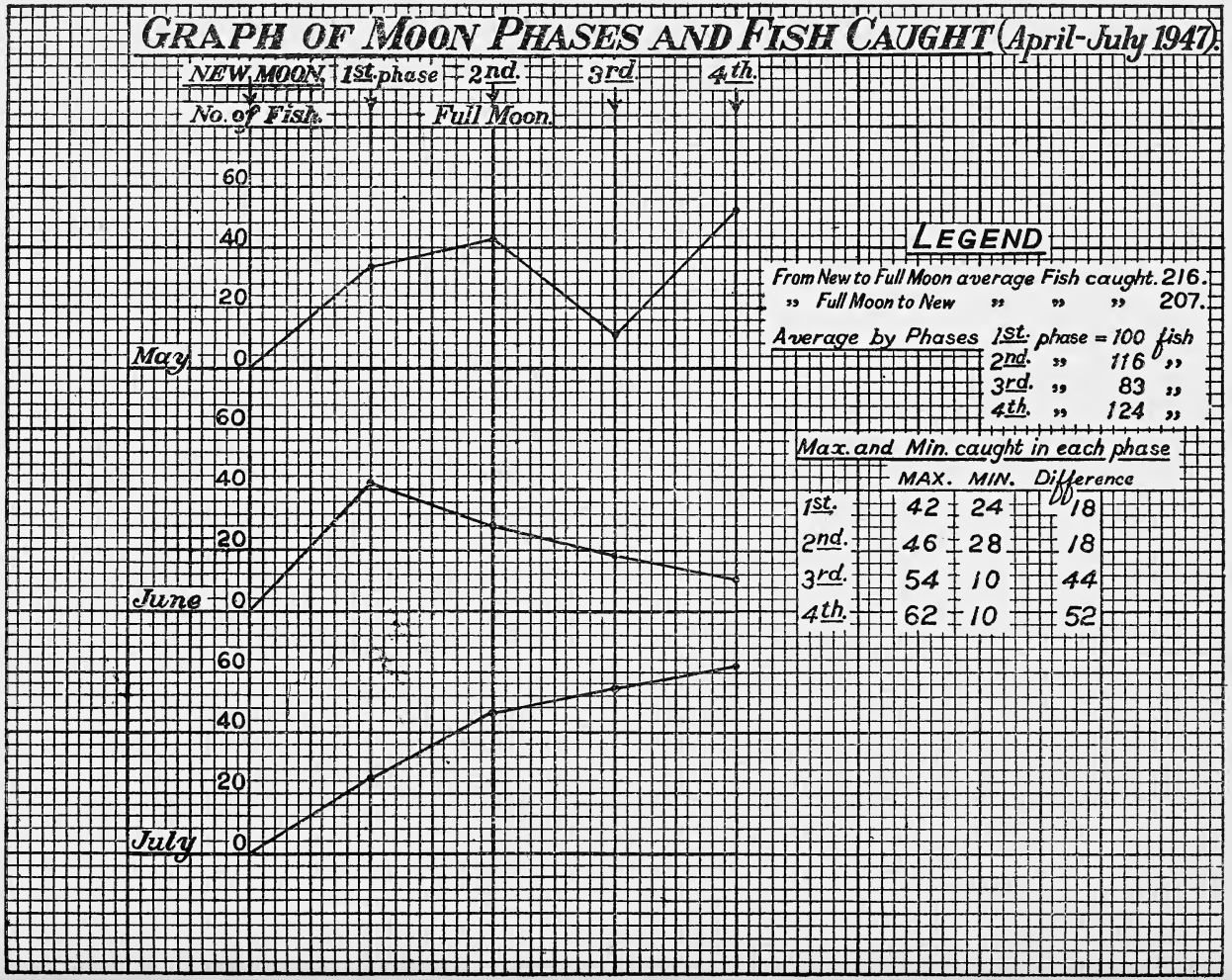
Condition 5 (no wind): Heavy wind is undoubtedly adverse but a light breeze rippling the surface is hereabouts essential for success with the fly, the gram and the unshelled groundnut used dryfly fashion.

I never fished during a thunderstorm but repeatedly observed mass distress amongst fish and sometimes heavy mortality after a violent thunder-and rain-storm.

Whether this is caused by the sudden lowering of the water temperature due to abundant cold rain, or whether the electric phenomena accompanying the storm are involved is not within my knowledge.

I firmly believe in the influence of atmospheric pressure and am sure that if Mr. Gee will continue his barometric observations very interesting results ought to ensue.

As for the influence of the phases of the moon on the appetite of fishes I have never noticed any and am frankly sceptical about anything of the kind.'—Eds.]


GRAPH OF MOON PHASES AND FISH CAUGHT (April-July 1947).
NEW MOON
1st. phase
2nd.
Full Moon.
3rd.
4th.
No. of Fish.
60
40
20
0
May
June
July
LEGEND
From New to Full Moon average Fish caught. 216.
" Full Moon to New " " " 207.
Average by Phases 1st. phase = 100 fish
2nd. " 116 "
3rd. " 83 "
4th. " 124 "
Max. and Min. caught in each phase
MAX. MIN. Difference
1st. 42 24 18
2nd. 46 28 18
3rd. 54 10 44
4th. 62 10 52

24.—MOONSTRUCK—FISH OR ANGLERS?

(*With a graph*)

There is a firm belief with some anglers, that the phases of the moon influence the feeding habits of fish. Conway, in his book 'Sunlit Waters' makes reference to this on p. 123, and claims to have kept records over two years which supported his views, but details are unfortunately not given. The localities and seasons would have been interesting.

The theory is generally accepted in the case of marine fishes, so much so, that professional fishermen and anglers alike study the tides as the main factor, but of inland fishes it remains an open question.

As a matter of interest I have prepared a graph of three months results while fishing the Kumaon lakes with unbroken continuity. The period is taken over three lunar months, from April 28th to July 20th 1947.

In all, 423 fish were taken in 72 fishing days. All three lakes were visited regularly and fished in the same way. The fish were all mahseer (*B. tor putitora*) and caught on fly and fly-spoon, with only a few caught during the heat of the day on atta. The results, as will be seen from the graph, are anything but consistent. I wonder if anyone among our members has results to support the theory?

I have personally never attributed any importance to the belief, but on the contrary, selected the full moon period to fit in with a fishing holiday so that it may help with sitting up for tiger, and had satisfactory results with the rod. But we live and learn!

CALCUTTA, A. ST. J. MACDONALD
25th May, 1949.

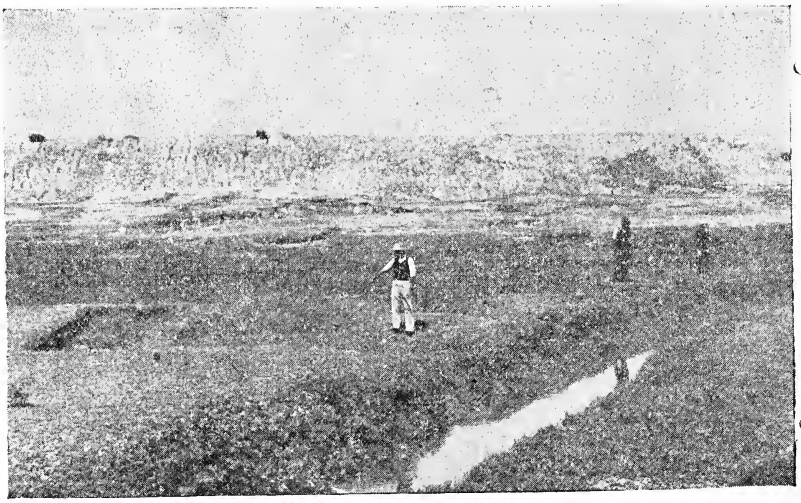
25.—ON THE CULTURE OF GREY MULLETS IN ASSOCIATION WITH COMMERCIAL CARPS IN FRESHWATER TANKS IN BENGAL

(*With a photo*)

In an earlier article, the writer (Pillay, 1947) indicated the desirability of culturing suitable fish compatibles in mullet farms for a more economic utilization of ponds' fodder resources. Lin (1940) reported the successful practice of culturing carps together with grey mullets in brackish water ponds of Hong Kong and presumed that this practice was probably something new in pisciculture. During an investigation on the biology of *Mugil tade* Forsk. and its culture, which is now in progress, the writer had opportunities to visit some coastal villages on the contai coast (Midnapore District, West Bengal) and study the age-old system of mullet culture in freshwater tanks in association with carps practised in this area. In view of Lin's remarks quoted above, it is considered necessary

to place on record the information thus collected regarding this very interesting system of mixed fish farming.

The general preference for freshwater fish for the table is widespread in Bengal, and even the sea fishing centres form no exception. Culture of carps is, therefore, undertaken in freshwater tanks even in the coastal region of Contai. Carp spawn is not available locally, and the fishermen have to obtain their supplies from the Balasore area in Orissa. Due to the distance and transport difficulties, the outlay needed to secure spawn is comparatively high. The mortality during transit is also very high, so much so that an average tank in this area remains understocked as far as carps are concerned. But the resourceful fishermen have found it advantageous to stock them with an adequate number of grey mullet fry, to increase the yield from their tanks. Mullets



A typical collecting centre for mullet seed

are greatly esteemed in the locality, more so when caught from freshwaters. The fact that they grow very rapidly in freshwaters (Hora and Nair, 1944) has been well realised by the fishermen and so their culture in tanks is very popular. The main species utilized for culture are:—Ainj (*Mugil cephalus* Linn.), Dhoka (*M. tade* Forsk.) Kannua[1] (*M. corsula* Ham.), Parsia (*M. speigleri* Blkr.), Khorsla[1] (*M. parsia* Ham.), the first three species being preferred because they grow rapidly and attain a large size within a comparatively short period. Mullet culture in freshwaters is in vogue in Madras also (Job and Chacko, 1947).

Along the Contai coast, there are numerous narrow tidal streams and creeks, and connected with these are several borrow pits dug for the construction and repairs of the sea-dyke guard-

[1] In other parts of Bengal, *M. corsula* is known as khorsula and *M. parsia* as parsia.

ing the coast from the tidal storms of the Bay of Bengal. These streams, creeks and pits form the important source of mullet seed for culture. The accompanying photograph shows a typical collecting centre at Baguranjalpai—a village near Contai. The high water brings with it numerous fry ranging from $\frac{3}{4}$ inch to 2 inches size, and when the tide recedes a good number of them remain in the borrow pits and pools. The fishermen collect these, by means of fine-meshed dip nets. Pieces of cloth (gamcha) are also employed sometimes for the purpose as described by Basu (1946). The fry thus captured are transported in earthen handies, in the same manner as carp fry. Though mullet fry are available in the area for at least 6 months in the year, different species predominate at different periods. Fry of Ainj (*M. cephalus*) and Parsia (*M. speigleri*) are available during March-April and Khorsla (*M. parsia*) from October to November. Dhoka and Kannua fry (*M. tade* and *M. corsula*) are abundant in July-August. The fry thus obtained are directly introduced into freshwater tanks. The fry collection centres being very near to the tanks, there is practically no mortality during this transference.

No artificial feeding or manuring is done here, but despite this the growth of mullets in the tanks has been found to be very encouraging. The growth rates of different species reported by the fishermen, are as follows:— In an average tank, *M. cephalus* grows to about 16 inches in one year and attains a weight of about 5 to 6 lb. in two years' time....*M. tade* introduced in July-August attains only about 6 inches to 9 inches by the end of the first year but it grows more rapidly in the second year and weighs about 3 to 4 lb. at the end of it. *M corsula* measures 4 to 5 inches in the first year and reaches 14 to 18 inches in about 3 years. *M. speigleri* and *M. parsia* do not grow to a very big size and usually they are fished out at the end of the first year when they measure about 5 to 6 inches. Mullets feed near the margins of the tanks and do not interfere with the normal feeding of carps. Being non-predaceous, they do not affect the growth and well-being of each other. Thus it appears that carps and mullets form suitable associates in ponds in coastal and estuarine areas in India also as in China, and mixed farming on these lines may be well worth popularising.

Another aspect revealed by this age-old practice is that the laborious process of acclimatization and conditioning (Devanesan and Chacko, 1943, and Venkataraman, 1944) may not be necessary if small fry collected from creeks and backwaters are to be used for stocking and the seed is not to be transported to very distant places. During a recent visit to the Sir Daniel Hamilton's Estate in Gosaba (24 Parganas, West Bengal) it was found that *M. tade* are directly introduced into tanks in the fingerling or more grown-up stages from Bheris, without any appreciable mortality. Spurgeon (1947) has shown that they ascend freshwater courses from estuaries and get naturally acclimatised. The popular practice of allowing mullets to graze in freshwater in paddy fields (Hora and Nair 1944) also lends support to this view.

The writer's grateful thanks are due to the National Institute of Sciences of India for the award of an I.C.I. (India) Research Fellowship which provided the opportunity to observe this interesting practice.

Zoological Survey of India Laboratories,
Calcutta, T. V. R. PILLAY
21st July, 1949.

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26.—SOME OBSERVATIONS ON *APLOCHEILUS LINEATUS* (CUV. & VAL.) IN MADRAS PROVINCE *

The Top-minnow, *Aplocheilus lineatus,* occurs in South Kanara, Malabar and Tirunelveli districts. The maximum size of the fish so far recorded is 9.5 cm. Its food is found to consist of corixid bugs, small beetles, water mites, insect larvae including mosquito larvae, ants, phytoplankton (*Merimopedia, Spirulina, Crucigenia, Mougeotia, Amphora, Cyclotella, Melosira, Pinnularia* and *Synedra*), and zooplankton (*Euglena, Phacus, Diaphanosoma, Ceriodaphnia, Diaptomus, Cyclops, Eucyclops* and *Nauplius*). When reared in aquaria, the fish is found to consume young *Gambusia, Lebistes* and carp fry. It also thrives well on prawn-shell meal, earthworms and other artificial food. It is very active and agile, and has been observed to jump over a two-foot wall of a garden pond. The fish is thus mainly insectivorous; and is suitable for control of mosquito larvae. Its larvicidal propensities have already been reported by

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

Bently[1], Deraniyagala[2], Fraser[3] and John[4]. In the laboratory of this station, a single specimen of the species was observed to feed on 270 mosquito larvae in 24 hours. The fish attains maturity when 50 mm. in size. Its breeding season extends throughout the year with a maximal from August to September. Our observations on the breeding and early development of the species do not show considerable variations from those of Job[5] and Jones[6].

A very remarkable feature about the fish is its occurrence in all types of water such as hill-streams and reservoirs at high altitudes, rivers, tanks and wells of the plains, low-lying paddyfields and swamps, and estuaries and backwaters. It is hardy and is able to adapt itself quickly from one type of environment to another. It thrives even in foul waters containing sulphuretted hydrogen and red sulphur bacteria. For example, it is found to occur in the Hope Lake located at about 700 feet above sea level. The water in this lake is highly oxygenated, soft and slightly acidic with a pH of 6.3—7.5; and has very low calcium and chloride content (0.7 p.p. 100,000). The fish is also seen in the stagnant pools in the course of the Tambraparni river below the lake. It is found in abundance in the Periyar Reservoir situated at an elevation of 3,000 feet. The water in it is soft, acidic and very low in calcium and chloride content. The occurrence of the species has been noted in the upper reaches of the Mannantoddy river at an altitude of 2,000 to 3,000 feet, whose waters are highly oxygenated, soft and acidic (pH—6.7), with very low calcium and chloride content (0.5 p.p. 100,000). The fish occurs in almost all tanks, ponds, wells, fields and swamps in the plains of Malabar, in which the ecological conditions vary from place to place. In the Coondapur estuary, where the chloride content is over 2,000 p.p. 100,000 and pH 8.0, the minnow is found in large numbers. In Dr. Rai's estate near Mulky, the minnow is found under interesting conditions. Sea water enters into the estate through the Pollai canal and fills up one of the ponds during high tide. This salt water pond is connected to a freshwater pond through a small channel. The fish was found in both the ponds and freely moving from one to another. The chloride content and pH of the ponds were 1250 and 7.9 and 610 and 7.5 respectively. The fish is also found in the creeks of the Cochin backwaters containing red sulphur bacteria and where the pH and chloride content are about 7.9 and 2,000 p.p. 100,000. The oxygen content is less than 1. occ/1. The fish is thus unaffected even by adverse environmental changes.

FRESHWATER BIOLOGICAL STATION, P. I. CHACKO
KILPAUK, MADRAS, S. V. GANAPATI
July 1949.

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27.—FOOD ORGANISMS OF THE CARP *LABEO BOGGUT* (SYKES) *

Labeo boggut is one of the common carps of the Tungabhadra and Krishna drainages. It breeds during the flood season (July to October) when its juvenile stages occur in large numbers. Though growing to a size of about eight inches only, the easy availability of its seed makes it a valuable addition for stocking inland waters.

The following is a table of the food organisms and their frequency of occurrence in 100 specimens of the fish collected from the Tungabhadra river near about Sunkesula village in Kurnool district, in the months of May, June and July 1948.

Kind of food organism	No. of stomachs containing organism	Average % volume in all stomachs	Greatest % in any stomach
MYXOPHYCEAE:			
Anabaena ...	14	2	10
Aphanocapsa ...	12	2	10
Coelosphaerium ...	4	—	—
Lyngbia ...	28	5	25
Merismopedia ...	47	12	30
Nostoc ...	18	3	20
Oscillatoria ...	51	18	75
Spirulina ...	22	4	10
BACILLARIEAE:			
Achnanthidium ...	2	—	—
Amphora ...	3	—	—
Cocconeis ...	13	—	5
Cyclotella ...	39	1	5
Cymbella ...	14	—	—
Eunotia ...	79	10	20
Fragilaria ...	84	12	25
Frustulia ...	4	—	—
Gomphonema ...	76	5	20
Gyrosigma ...	42	2	12
Mastogloia ...	31	2	10
Melosira ...	46	2	10
Navicula ...	9	—	—
Nitzschia ...	56	7	20
Pinnularia ...	6	—	—
Pleurosigma ...	6	—	—
Stauroneis ...	8	—	—

* Read before the zoology section of the 36th Indian Science Congress, 1949; and communicated with the kind permission of the Director of Industries and Commerce, Madras.

Kind of food organism	No. of stomachs containing organism	Average % volume in all stomachs	Greatest % in any stomach
Surirella ...	4	—	—
Synedra ...	67	2	10
Tabellaria ...	42	2	10
CHLOROPHYCEAE :			
Ankistrodesmus ...	45	4	20
Closterium ...	66	5	25
Cosmarium ...	8	—	—
Desmidium ...	37	2	5
Euastrum ...	1	—	—
Microspora ...	15	2	5
Mougeotia ...	37	12	35
Oedogonium ...	81	15	40
Oocystis ...	5	—	—
Pediastrum ...	26	2	5
Pleurotaenium ...	17	7	20
Scenedesmus ...	32	2	10
Spirogyra ...	72	30	80

The fish chiefly browses on algal matter and on the bottom scum. Diatoms and desmids also enter its food as minor items. It is noteworthy that animal matter is totally absent in its diet. This is the first record of the food and feeding habits of this species.

FRESHWATER BIOLOGICAL STATION, P. I. CHACKO
KILPAUK, MADRAS, (MISS) SHARADA SUBRAMANIAN.
May 1949.

28.—A REMARKABLE ABERRATION OF *A PAPILIO POLYTES ROMULUS* CRAM

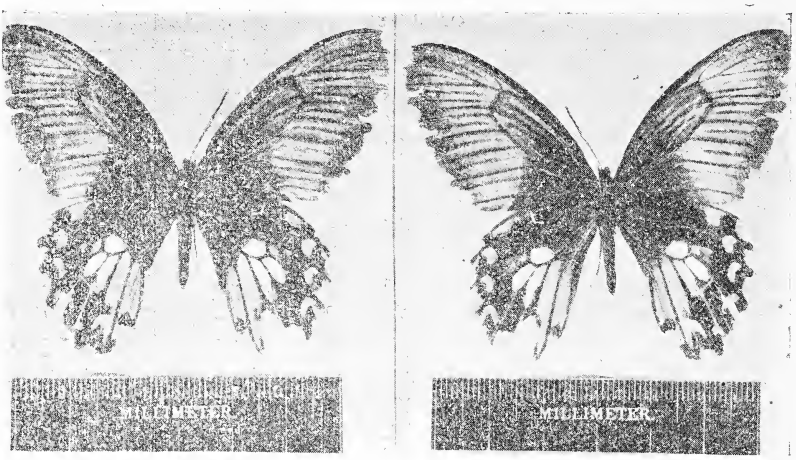
(With a photo)

I have pleasure in sending you two photographs illustrating the upper and under sides of an aberrant specimen of a *Papilio polytes romulus* Cram. collected by Mr. A. Bell at Jeolikote below Naini Tal at about 5,000 feet elevation.

The following is a brief description of this specimen very kindly furnished by Mr. A. G. Gabriel of the British Museum, to whom the specimen was presented:—

Upperside. Forewing normal. Hindwing: a white marking edged with buff-coloured scales occupying the apical third of the discoidal cell, and white elongate markings in interspaces 2 and 3 beyond

the cell; two elongate buff-pink markings in interspaces 1/b and 1/c; the submarginal spots also buff-pink; marginal lunules white as in the typical form.



Upperside Underside

Underside. The markings are similar in colour and position to those on upperside.

This remarkable aberration appears to be unique and there is nothing like it in the collection of the British Museum. Brigadier W. H. Evans, who saw the specimen, said that he had never come across anything like it.

Very unfortunately the butterfly was in much tattered condition when caught.

The photographs were also supplied by the British Museum.

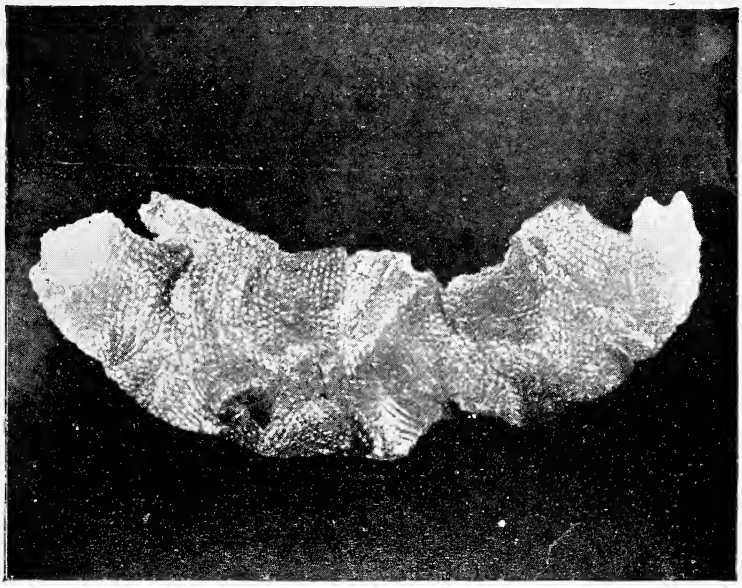
116, Koregaon Park,
Poona, M. SUTER, D.Sc.
14*th July* 1949.

29.—THE EGG MASS OF A DOLIID GASTROPOD MOLLUSC FROM KRUSADAI ISLAND

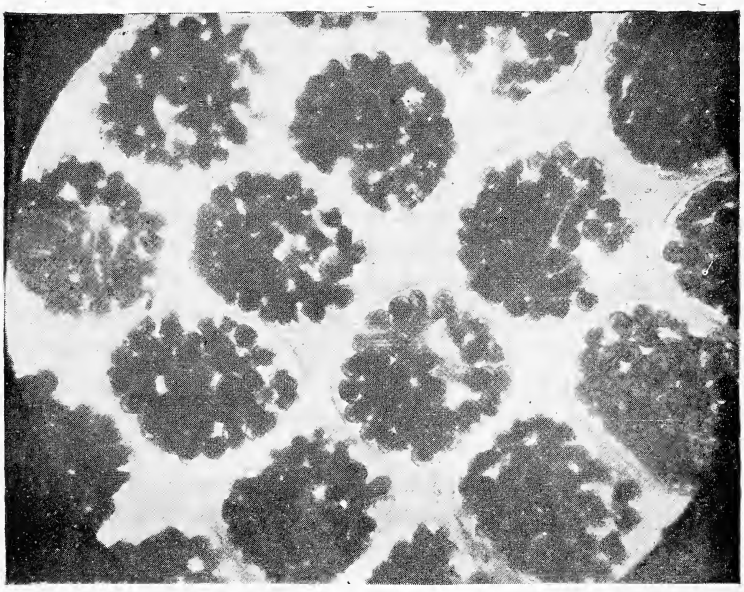
(*With a plate*)

During a visit to Krusadai Island in 1947 we found a few gelatinous ribbons washed ashore at Kundugal point on 25-2-47. On examination, these proved to be the egg masses of a gastropod mollusc. In addition to the fresh spawn mass in which the embryos were alive, there were four other ribbons which on account of exposure to the sun had become tough and leathery, superficially resembling the cast skin of snakes.

The spawn masses were brought to the laboratory and kept alive for three days. The ribbons were from 250 to 380 mm. long, 60 to 70 mm. wide with a wavy margin and a thickness



1. General view of egg-ribbon of *Dolium* sp.
(Specimen incomplete—broken during preservation)



2. A few of the capsules enlarged showing the numerous veligers inside.

of about 1.5 to 2 mm. Inside each ribbon were numerous transverse rows of 28 to 34 capsules arranged in curved rows (photo 1). Each capsule was oval in shape, of an average diameter of 2 to 3 mm. and with a wall of fibrous texture and having a round aperture on the surface. On an average 75 to 85 veligers were found inside each capsule except in those which were empty. Most of the veligers were in the early stages of development but clearly showed sculptured shells of a brown colour. An operculum and a velum consisting of several lobes were also present.

Subsequent examination of the material was not possible as the veligers died and the material remained unidentified. Inquiries at Krusadai revealed that similar spawn masses were not previously recorded from that area; nor are there any descriptions of similar egg masses in Hornell's Common Molluscs of South India.[1]

A comparison of the description and figures of the egg mass of *Dolium* (? *maculatum* Lam.) from the Iranian Gulf given by Thorson[2] with our notes and illustrations and the preserved spawn brought with us leave no room for doubt as to the identity of our material. The Iranian egg mass was 300 mm. long, 90 mm. wide and 2 mm. thick with curved rows of capsules numbering about 30 across the ribbon, each capsule containing 91 to 101 embryos, a number much larger than in our material. These broad gelatinous ribbons without sand incrustations are said to be characteristic of the genus *Dolium* and were first described by Lo Bianco[3] from the Mediterranean. From the dried ribbons we have been able to make out that in the early phases, the eggs inside the capsule are distributed in a semilunar mass as described by Thorson and, presumably, when the eggs develop, they spread out and occupy the whole cavity of the capsule (photo 2).

It seems certain that the egg masses which we collected at Krusadai can be referred to a species of the genus *Tonna* (=*Dolium*) but specific identity can be established only by further work. Gravely[4] has recorded four species of Doliids as occurring in South India. These are:—

Tonna dolium (Linnaeus) (=*Dolium maculatum*)
Tonna cumingii (Reeve) (=*Dolium cumingii*)
Tonna fasciata (Lamarck) (=*Dolium fasciata*)
Tonna pomum (Linnaeus) [=*Dolium* (*Malea*) *pomum*]

As there do not appear to be any published photographs of the egg ribbons of Dolium, we feel the accompanying photographs will be of interest.

CENTRAL MARINE FISHERIES, RESEARCH STATION, MADRAS/MANDAPAM, *July* 1949.

N. K. PANIKKAR
P. R. S. TAMPI

REFERENCES

1. Hornell, J. (1922): Common Molluscs of South India. *Madras Fisheries Bulletin*, **xiv**: 97-215.

2. Thorson, G. (1940): Studies on the egg masses and larval development of Gastropoda from the Iranian Gulf. *Danish Scientific Investigations in Iran* Copenhagen, Pt. 2: 159-236 (pp. 192-95).

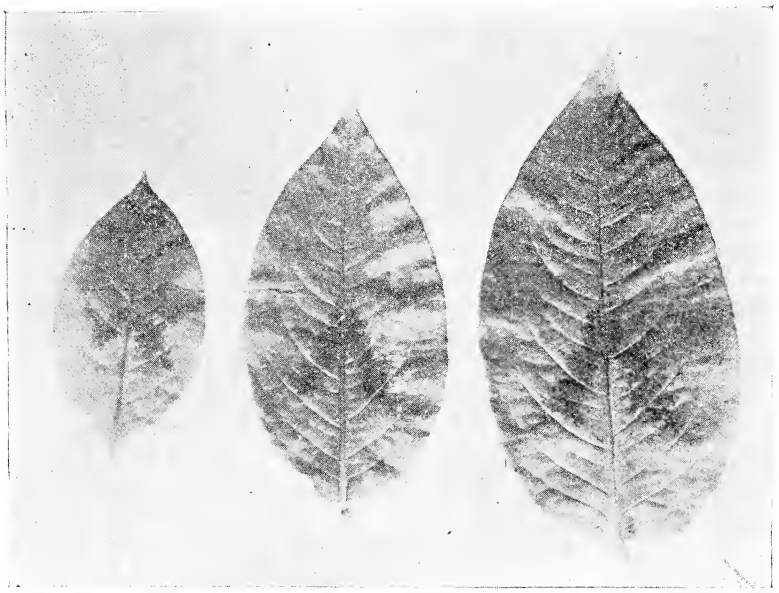
3. Lo Bianco (1888 & 1908): Notizie biologiche riguardanti specialmente il periodo di maturita sessuale degli animali del golfo di Napoli. *Mitth. Zool. Stat. Neapel*, 8: 385-440 (p. 417); 19: 513-761 (pp. 635-36).

4. Gravely, F. H. (1942): Shells and animal remains found on the Madras beach. *Bull. Madras Govt. Mus. Natural History* series II, p. 98.

30.—THE 'VICTORY PLANT'

(With a photo and two text figures)

The leaves of *Polygonum*, as is well known, bear various kinds of marks on their surfaces. One particular species of this genus growing in the departmental garden was noticed to bear on all its leaves a V mark (see photo). Leaves of the same species growing in other places also bear the same mark showing that it is no chance occurrence but a distinctive feature of the leaves.



The V mark is dark brown or dark violet in green leaves. In leaves which have turned pink the mark may be dark green in colour. The point of the V is invariably and without a single exception pointed towards the tip of the leaf. The mark is very definite and conspicuous in green and young leaves. As the leaves grow older and bigger the mark also becomes enlarged, diffuse, fainter and occasionally even irregular in outline. But the essential V form is always maintained. The mark is found only on the upperside of the leaf, never on the lowerside. Dried

up leaves and herbarium specimens also show the mark, but rather faintly.

In this species a very young leaf is completely enclosed within the stipular sheath; such a leaf does not show the mark. An older leaf which has outgrown the stipule shows the mark faintly, with the stipule adpressed against the upper surface of the revolute leaf. In fact the stipular tip often occupies the bay between the arms of the V mark, almost suggesting a possible connection between the mark and the stipule.

Sections taken through the region of the mark do not show any peculiarity except that certain cells of the palisade tissue only in the marked region show violet coloured cell sap. This probably explains the presence of the mark on the upper-side and not the lower. It is not unlikely that the violet colour of the sap is due to an anthocyanin pigment. Several species of *Polygonum* are known to bear anthocyanin pigment in their leaves (Garjeanne, A., 1903. Buntblätterigkeit bei Polygonum, *Beihefte Botaniscehen Zenteralblatt*, Bd. XIII, s. 203). Wheldale further mentions that anthocyanin pigments occur in the subepidermal region in the older leaves in *Polygonum* (The Anthocyanin pigments of plants, 1916, Cambridge University Press, p. 41). It is worth noting that although all the leaves bear the V mark, the leaves are all not green in colour, the colour varying from green to pink and red, in the same plant. This is very suggestive of widespread anthocyanin activity.

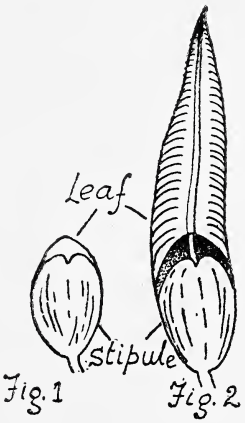


Fig. 1 Fig. 2

How exactly the V mark arises is not clear. A possible explanation is this. The young leaf at first is fully protected within the stipular sheath. When it outgrows the stipule in its development a portion of the young leaf is exposed to light as in fig. 1. This exposed area develops the pigment probably as a chromatic adaptation to light. Then the rest of the leaf grows up perhaps at a very rapid rate, without there being any necessity for further chromatic adaptation. But the area that has already developed the pigment retains it as in fig. 2.

The most interesting point about the V mark as compared with other kinds of marks on the leaves of *Polygonum* is its astonishingly constant occurrence, definiteness and disposition. Evidently it is one of those characters that are transmitted from generation to generation—a mendelian character. So far as I am aware the presence of this mark on the leaves of *Polygonum* has not been clearly or adequately mentioned in any of the standard taxonomic works, although it has been figured on the leaves of *P. persicaria* var. *genuinum* (Sowerby's Botany, edited by J. T. B. Syme, Vol. 8. pl. 1237) and *P. alatum* (P. F. Fyson, Flora of the Nilgiri and Pulney hilltops. Vol. 3, p. 473).

Quite a lot of amusement was created when the leaf was exhibited as the *Victory Leaf*—at the conversazione held during the Convocation week in January 1948—during India's first year of independence. In fact the plant has come to be better known amongst students as the *Victory Plant* rather than as *Polygonum*!

Department of Botany and Geology, A. R. RAO
University of Lucknow,
Lucknow,
1st September 1948.

31.—BOUGAINVILLEAS AT HILL-STATIONS

Dr. N. L. Bor, when dealing with the above in his interesting articles on 'Some Beautiful Indian Climbers and Shrubs', says that they will grow almost anywhere 'except at hill-stations'.

There is in Ootacamund (elevation 7,400 feet, Nilgiris) a very fine specimen which is just now a mass of magenta-coloured bracts. It is as beautiful as most of those I have seen on the plains or elsewhere. Several varieties are commonly grown in Coonoor (elevation 6,000 feet) and do quite well.

Kenilworth, CHAS. M. INGLIS
Coonoor, Nilgiris, F.Z.S., C.M.B.O.U.
29th April 1949.

32.—THE GENUS *CEROPEGIA*: FURTHER COMMENTS*

In a recent note published in the *Journal* (**47**: 775—777, 1948) the writer remarks 'It is somewhat astonishing then, that Hooker was able to identify his own plant as being the *C. odorata* of Nimmo'. But the writer has not mentioned any of Hooker's specimens which Hooker, according to the writer's statement, must have used as the type material to base his description. Instead of Hooker citing his own specimen as the type of his species, he cites only Nimmo's sheet from Salsette, besides another of Law in Hooker's 'Flora of British India,' iv, p. 75. It is, therefore, unambiguously clear that Hooker had seen Nimmo's specimen and that of Law, to serve him the material for describing the species as otherwise, an elaborate description like the one he has given in the Flora of British India (vol. iv, p. 75) is impossible. If Nimmo's sheet was not available for him, he would have quietly omitted the Nimmo's species under *species dubia* as is usual with him. I, therefore, contend that Hooker f. has seen Nimmo's sheet and has described it fully from that type. Its absence from the Hookerian Herbarium does not preclude its presence elsewhere. Nimmo collected this plant long before the Kew Herbarium came

* The material for the note was gathered during the writer's stay at the Calcutta Herbarium in December 1948.

into existence, and it is quite possible that the type of Nimmo is not in Kew and may be present in some other herbarium.

Uuless and until it is definitely known that Nimmo's Salsette specimen does not exist anywhere except in the fertile brain of Joseph Hooker, Hooker's description of Nimmo's name, *'Ceropegia odorata* Nimmo ex Hk. f.' should be recognised as having been validly published.

Dept. of Botany, R. SESHAGIRI RAO
P.R. College,
Cocanada,
8th May 1949.

33.—THE GENUS *CEROPEGIA*: STILL FURTHER COMMENTS

None of the authors who have been writing on the flora of Bombay since the publication of Graham's Catalogue in 1839, with the possible exception of Hooker, has seen the type of *C. odorata* Nimmo. Cooke, who wrote his Flora under the watchful and very sensitive eye of Dr. Hooker, failed to see not only Nimmo's type, but apparently any other sheet of this species, and in consequence he omitted *C. odorata* Nimmo from his book. These omissions call for an explanation.

The type of Nimmo's plant is not found in Hooker's or Wight's herbaria; it is not in the British Museum, nor in the Linnean Society; if it were in the Calcutta herbarium we should have heard about it long ago. My contention is that until the type be produced, no one can identify Nimmo's plant for a certainty, and therefore his binomial must remain a *nomen dubium;* moreover, if Nimmo's plant remains doubtful, its identity with Hooker's plant must likewise remain uncertain.

Much emphasis is laid on the fact that Hooker in his Flora mentions 'Nimmo's sheet from Salsette'. Graham in his Catalogue, after No. 898, writes: 'Three new species, discovered by Mr. Nimmo, in the Concans'. The first of these three species of Graham is *C. odorata* N. In the absence of the proper herbarium sheets, I consider this reference of Graham as the source from which Hooker derived his information as regards Nimmo's plant.

This question could easily be solved if we could find Nimmo's type, but of this I see little hope. Nimmo did not keep a herbarium, nor did he keep any large collection of Bombay plants. In the extensive correspondence of Nimmo kept in Kew herbarium there is no mention of such a collection; moreover, in the course of two years spent in Kew herbarium I went through most of the Indian plants; Hooker's and Wight's private herbaria are included therein, and were carefully examined; in all I found about 5 or 6 plants from Nimmo, and none of these is the type in question.

Nimmo's description of the plant is too short and too vague; until his type be produced, the identity of his plant with that of Hooker will remain doubtful. Provided such an identity can be

established satisfactorily, then it is correct to write '*Ceropegia odorata* Nimmo ex Hook. f.'; *but the crux of the matter is precisely in proving such an identity in the absence of the type.*

St. Xavier's College, H. SANTAPAU
Fort, Bombay.

34.—MASS FLOWERING OF *STROBILANTHES KUNTHIANUS* ON THE HIGH WAVY MTS., IN AUGUST 1948.

Last year the whole of the grassy eastern and western facing slopes of the High Wavy Mts., above 5,000 feet were covered in a mass of blue flower, during the month of August. According to eye witnesses the mass flowering was very even throughout the area, and continued up to over 6,000 feet. The last mass flowering was in August 1936. Last year's flowering, however, covered a far greater area than before as *Strobilanthes kunthianus* has spread over many areas where it did not previously exist. A few odd plants have flowered in odd years here and there, but in August 1946 I came across a patch about two hundred acres in area which was a sheet of blue. This patch was in the extreme south-west of these hills, and was surrounded on all sides by *Strobilanthes* which was not flowering.

It is curious that a patch like this should be two years earlier than the rest. I do not know whether this same patch was two years earlier than the 1936 mass flowering or not, but it will be interesting to see what it does in 1958.

Injiparai Estate, A. F. HUTTON
Valparai P.O.,
Coimbatore District,
11th May 1949.

[This accidental flowering of some *Strobilanthes* plants one or two years before the general flowering has been noted for other species of the same genus by Santapau in the *Journal* (**44**: 605, 1944). After the general, there may follow some sporadic flowering for one or more years, and for this reason it may be of interest to keep *Strobilanthes kunthianus* under observation. Exact data about the partial or general flowering of *Strobilanthes* are needed, and readers from various parts of India will be rendering a service if they will communicate to the Society any precise data on the subject.—Eds.]

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1948.

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Dr. Baini Prashad., D.SC.	*New Delhi*

THE HONORARY SECRETARY'S REPORT FOR THE YEAR 1948

The Society's Journal

Volume 47, Nos. 3 and 4 and Volume 48, No. 1 were published during the year. The last number was again considerably delayed in reaching members. Every effort is being made to make up time so that future issues may be more punctual, but our press unfortunately seems helpless in the matter.

Mammals

In 'Bat Migration in India and other Notes on Bats' (Vol. 47, No. 3, p. 522), Humayun Abdulali gives some particulars of an experiment on bats undertaken by him in 1942-43 of ringing several species of bats in the various caves on Elephanta Island in Bombay

Harbour, with a view to studying their local and migratory movements. The experiment was made on a modest scale and could not be persisted in for a long enough period, but it suggested the great possibilities inherent in this method for obtaining data on this much neglected branch of mammalogy. The article closes with a reference to various recent researches in the U.S. and elsewhere particularly on the senses in bats and their ability to avoid collision with obstacles in their flight even when blinded which suggest that this is done by 'echo location'. Bats produce supersonic cries as they fly which though inaudible to the human ear serve by their echoes to guide them clear of intervening obstacles.

An impassioned plea for the protection of wild life is contained in Lt.-Col. R. W. Burton's 'Wild Life Preservation: India's Vanishing Asset' (Vol. 47, No. 4, p. 602). The author after pointing out the various Indian animals threatened with extinction states that forgetfulness, indifference, ignorance and greed for gain on the part of Man are responsible for the present depletion and unless prompt steps are taken by Government to protect our wild life through the enactment of adequate laws and their efficient enforcement, control of firearms and finally an enlightened public opinion, many of our animals would vanish before our eyes. Col. Burton recommends the establishment of a Wild Life Department separate from the Forest Department, whose officials already overburdened with their own considerable work will not be in a position to devote their full attention to a subject such as this which requires constant observation and study. He would have it linked instead through the Ministry of Agriculture with the Provincial Agricultural and Forest Departments while a Central Game Fund is maintained in the Office of the Ministry of Agriculture. The article is followed by an extensive and useful bibliography on wild life protection in India.

Among the popular papers one that will appeal particularly to sportsmen is 'Jungle Memories' Part I—Tiger—by Lt.-Col. E. G. Phythian-Adams (Vol. 48, No. 1, p. 125). As the title indicates this article contains many interesting anecdotes of tigers and several valuable wrinkles for the young shikari in India. Col. Phythian-Adams has drawn freely from his shikar diary kept over a period of nearly 40 years in various parts of India but mostly in the Nilgiris. Further parts of the serial are to be published in the subsequent issues of the *Journal*.

In 'A Further Note on the Bearded Pig in Malaya' (Vol. 47, No. 4, p. 632) following an article entitled 'The Riddle of the Bearded Pig' by J. E. Kempe in a previous number of the *Journal*, C. A. Gibson-Hill of the Raffles Museum has made a valuable study of the distribution of this rare animal in Malaya. *Sus cristatus* was believed to be the only wild pig occurring in Malaya until 1918, when the first specimen of the Bearded Pig, *Sus barbatus* was obtained from Pekan. Since then several other records had turned up, but though plentiful in the adjacent islands of Sumatra and Riau Archipelago, its existence in Malaya side by side with *cristatus* remained a riddle and it was believed to be only an accidental straggler from the neighbouring islands. The subsequent

discovery among the deposits excavated from certain lime-stone caves in the peninsula, of tushes of *barbatus* has now established the animal to be indigenous to the mainland. Gibson-Hill after examining all the available records of its occurrence both prehistoric and contemporary, takes the view that the Bearded Pig has survived in Malaya from Neolithic times in isolated pockets in small numbers, 'erupting' at intervals into more densely inhabited areas.

Birds

'The Birds of the Mishmi Hills' by Sálim Ali and S. Dillon Ripley is among the important regional papers published during the year (Vol. 48, No. 1, p. 1). This area was relatively unknown ornithologically until the present survey was undertaken which accounts for the 14 new forms reported in this paper. A discussion of the geology of the Mishmi Hills, its altitudinal and life zones and the affinities of its avifauna contribute to the importance of the study.

'Some Birds of the Gandak-Kosi watershed, including the pilgrim trail to the sacred lake of Gosainkund' (Vol. 47, No. 3, p. 432) is the ornithological diary of Mr. B. E. Smythies of the Burma Forest Service during his trip to Nepal. A list of 45 birds seen during this trip and useful notes on many of them make it a valuable contribution to the little known ornithology of Nepal.

'The Storm Petrels occurring in the Northern Indian Ocean and Adjacent Seas' by C. A. Gibson-Hill (Vol. 47, No. 3, p. 443) is again a study in distribution of the 4 species of storm petrels recorded from the Indian Ocean—Wilson's, the Black-bellied, the British and Swinhoe's.

The first of a serial on the taxonomy of Indian birds is Dr. S. Dillon Ripley's 'Notes on Indian Birds' (Vol. 47, No. 4, p. 622) which deals with the races of the Pipit *Anthus hodgsoni*. The author, basing his work on the collections in the U.S. National Museum, the American Museum of Natural History, the Academy of Natural Sciences and the Museum of Comparative Zoology and Peabody Museum and his own collections from the Mishmi Hills recognizes 4 races and provides a workable key for their identification. With this paper Dr. Ripley makes his debut in the *Journal*. We shall hope to see more and more of his contributions in our pages since he has now undertaken the gigantic task of preparing an up-to-date checklist of Indian Birds.

'A Census of Nests in a Private Bird Sanctuary' (Vol. 47, No. 4, p. 676) is the account of an ecological study of Indian birds made in the school compound at Dohnavur at the southern corner of the Madras Presidency. Mr. Webb-Peploe who contributed this article has since died, but it is hoped that at least a few of his colleagues and pupils with whose co-operation he has recorded these and other field observations on the animals of his area in the past, would keep up the interest he has infused into them.

'The Food Habits of 3 Kingfishers occurring on Singapore Island' were studied by Gibson-Hill (Vol. 48, No. 1, p. 146) with a view to testing the hypothesis that two species with similar ecology cannot live in the same area. The Indian Common Kingfisher

(*Alcedo atthis benghalensis*), the White-breasted Kingfisher (*Halcyon smyrnensis fusca*) and the White-collared Kingfisher (*Halcyon chloris humii*) were studied in this context and records within their whole breeding range were examined. A comparison of the structure of the bills of the three species was also made. As a result, he comes to the conclusion that though the same feeding methods are adopted by all the three, each seems to show a definite preference for three different fields, *Alcedo atthis* 'feeding typically and largely from and over water', *H. chloris* from 'mangrove mud-banks and muddy beaches' and *H. smyrnensis* from 'dry ground and open country away from water'.

Particulars of 72 rings recovered from marked birds shot or found dead within Indian limits, compiled from various sources and brought together in one place will prove of great use to students of bird migration (Vol. 47, No. 4, p. 690).

'Astanmarg' (Vol. 48, No. 1, p. 38) is a delightful account from the pen of Col. R. S. P. Bates of a holiday in this Himalayan valley and his encounters with its birds and flowers. The article is illustrated with some of Col. Bates's superb photographs.

Reptiles and Fishes

In his 'Notes on a few Reptiles from the Nilgiri Hills' (Vol. 47, No. 3, p. 552) Garth Underwood furnishes a list of 5 lizards and 2 snakes he collected in that area. The same author's 'Notes on Poona Reptiles' (Vol. 47, No. 4, p. 627) listing 1 tortoise, 13 lizards and 12 snakes include field notes on several forms.

That the King Cobra believed to be the fastest snake in India is no faster than the average good-sized rat snake, and that an average man running hard would have no difficulty in outdistancing either are the conclusions reached by S. K. Ghosh, of Calcutta, who narrates an exciting encounter with a King Cobra in the Sajek Valley in Assam (Vol. 47, No. 4, p. 760).

Among the more important papers on Fishes and Fisheries published during the year are the following:—

'Methods of collection and hatching of Carp ova in Chittagong with some suggestions for their improvement' by Nazir Ahmed (Vol. 47, No. 4, p. 593).

'Breeding and feeding habits of Mullets (*Mugil*) in Ennore Creek' by P. K. Jacob and B. Krishna Murti (Vol. 47, No. 4, p. 663).

'Some observations on the habits of *Hippocampus guttulatus*' by P. K. Jacob and A. D. Isaac Rajendran (Vol. 48, No. 1, p. 153).

Insects

Several regional papers on butterflies were published during the year of which the following are among the more important:—

'The Butterflies of the Andamans and Nicobars' by Lt.-Col. M. L. Ferrar (Vol. 47, No. 3, p. 470).

'The Butterflies of the Khasia and Jaintia Hills, Assam' by R. E. Parsons and Sir Keith Cantlie (Vol. 47, No. 3, p. 498).

'Local lists of Lepidoptera from the Punjab and U.P.' by D. G. Sevastopulo (Vol. 47, No. 4, p. 586).

Part XX of 'The Early Stages of Indian Lepidoptera' and 'The Food-plants of Indian Geometridae and Pyralidae' by the same author were also published. His 'Some suggestions for entomological work in India' published in Vol. 48, No. 1, p. 75, deserves to be read by every serious student of entomology. It contains valuable hints on lines of future work especially with regard to lepidoptera such as distribution, seasonal forms, diapause, temperature experiments, use of the secondary sexual apparatus, scents, intersexes produced by shock, palatability, colour perception, parasites, relations with ants, genetics, larval and pupal dimorphism, and hybridisation.

'Descriptions of Plant Galls from Travancore' by Dr. K. K. Nayar published in Vol. 47, No. 4, p. 669 listing 39 species of plants affected by galls suggests the scope of this study in a tropical country such as India.

Botany

The last part of 'Some Beautiful Indian Climbers and Shrubs' Part XXVIII (Vol. 47, No. 3, p. 401) dealing with *Bougainvillea* (Nyctaginaceae) by N. L. Bor and M. B. Raizada appeared during the year. It is proposed soon to have this popular serial published in book form.

Of systematic interest is Fr. H. Santapau's 'Notes on the Solanaceae of Bombay' published in Vol. 47, No. 4, p. 652. Although the paper is intended primarily to acquaint Indian botanists with modern work done in Europe and America on this family, the layman has much to benefit from the helpful keys given in the course of the article for several genera such as *Solanum, Datura,* etc.

The *Journal* maintained its usual interesting and varied crop of miscellaneous notes which always form such a popular feature.

A grant of Rs. 500 was received during the year from the National Institute of Sciences of India towards the publication cost of the *Journal*. For this the Committee wish to express their thanks to the Council of the Institute.

Publications

1. 'The Book of Indian Animals' by S. H. Prater. This, the second volume of the Society's Indian Natural History Series, was published in April. An edition of 3,000 copies has been printed out of which 802 were sold up to the end of the year. It contains 73 plates in colour and numerous line and half-tone illustrations.

2. 'Circumventing the Mahseer and other Sporting Fish in India and Burma' by Major A. St. J. Macdonald was published during the year. 1,000 copies have been printed out of which 169 copies were sold till 31st December. Slightly different in format from 'The Book of Indian Animals', it is attractively got up and profusely illustrated with 4 coloured and 17 black and white plates and 64 text figures. Its wealth of practical information on the different aspects of angling, will make it the fisherman's vademecum for many years to come.

3. 1,000 sets of coloured picture postcards of Indian birds specially painted for the 4th edition of 'The Book of Indian Birds' by D. V. Cowen were also published by the Society out of which 220 sets have been sold.

4. 'Some Beautiful Indian Trees' by Rev. E. Blatter and W. S. Millard. Although a print order for 2,500 copies was placed with Messrs. Oliver & Boyd, Edinburgh, Scotland, as early as 1947, the book could not be brought out yet. Mr. Millard is putting whatever pressure he can on the printers, and it is hoped that the book would be out soon.

The publication of the projected 'Book of Indian Butterflies' as Volume III of the Society's Indian Natural History Series is held up pending the decision of the Government of India regarding the publication grant applied for through the Council of the National Institute of Sciences of India. The letterpress and illustrations for it are completely ready. It will be recalled that this was one of the items on the list of our proposed publications for which a subsidy was asked from the Central Government.

Revenue Account

Actual receipts amounted to Rs. 37,796-7-7 as compared with Rs. 33,820-12-0 during the year 1947. This increase of Rs. 3,975-11-7 in the revenue is due to the income derived from the sale of the Society's new publications,—'The Book of Indian Animals', 'Circumventing the Mahseer and other Sporting Fish in India and Burma' and bird picture postcards. The total proceeds of the sale of publications in 1948 was Rs. 12,073 as compared with Rs. 6,322 in 1947.

Life Members. During the year 1948, 3 life members died but 6 joined increasing the total number from 210 to 213.

Ordinary Members. 141 new members (including one Honorary member) were enrolled in 1948. Against this 60 resigned and 12 died. The total membership on 31st December 1948 was 1,398 an increase of 69 over the previous year. It must be mentioned, however, that the actual number of active and paying members is far less—perhaps not more than about 800. Since the end of the war we have lost contact with many members who stand on our list. Some of these may have died and others may not wish to keep up their connection with the Society.

Educational Activities

With the appointment of the new Nature Education Organiser in February 1948, our educational activities which proved so successful during the period between 1926 and 1928 have revived. It is gratifying that the Government of Bombay have been convinced of the usefulness and desirability of the scheme and have since sanctioned the finance needed for carrying it out. The work of this section has been as under:—

1. Nine lectures in English in three courses were given by the Nature Education Organiser at the Museum to Nature Study teachers from local secondary schools on Birds, Mammals, and

Reptiles and Fishes followed by guided tours through the galleries. 247 teachers from 85 schools attended the courses.

2. A similar talk was given, but in Marathi and Gujarati to Nature Study teachers from primary schools followed by guided tours as before. 27 teachers from 14 schools took advantage of this opportunity.

3. As a result of these efforts, children from 50 schools visited the Museum accompanied by their teachers and the Nature Education Organiser took them round the galleries.

4. A leaflet was prepared in English setting forth the points to look for when inspecting the animals exhibited in the Museum and distributed to the schools for the use of the children.

5. Extramural lectures on animal life were given by the Nature Education Organiser at 5 schools.

Acknowledgments

The thanks of the Committee are due to Mr. W. S. Millard for his continued help in looking after the Society's interests in London.

Staff

Pending the appointment of a permanent Curator, Mr. Sálim Ali continued to look after the Museum in addition to acting as Honorary Secretary of the Society.

The Assistant Curator, Mr. V. K. Chari and office staff deserve a word of praise for the interest and co-operation they have shown in the satisfactory management of the Society's affairs.

APPENDIX TO THE HONORARY SECRETARY'S REPORT COVERING THE PERIOD JANUARY TO JULY 1949

Membership

It will be recalled that the Committee's resolution to increase membership fees was ratified at the Annual General Meeting held on 11th August last year. Members and the Executive Committee were naturally apprehensive of the effect this step might have on our membership strength. The enhanced fees came into force on 1st January and members will no doubt be interested to hear how they have been received. It is gratifying that the resignations due directly to the increased subscriptions have been far fewer than was feared. The number of new members joining since the commencement of the year has been less than during the same period of 1948 but this cannot be ascribed solely to this cause. It is just possible that a slowing down of effort on the part of existing members to enlist new ones may be partly responsible. The question of keeping up membership strength is vital to the Society, and the Committee looks to every individual member to do his utmost in obtaining at least one new member in the course of a year. This should not be beyond the power of anyone to do, and every member should treat it as his duty to the Society, if he wishes that the Society should continue to prosper. During the 7 months under review 47

new members joined including 5 life members (one new and 4 by compounding) and 36 resigned or died leaving us 7 to the good.

Government Grants-in-aid for Publication of the Journal

It is gratifying to report that our efforts, initiated through the personal interest of Sir Chintaman Deshmukh, to obtain financial assistance from Government to maintain unbroken publication of the Society's journal, during the period of its financial uncertainty following 15th August 1947, have borne fruit. A grant-in-aid of Rs. 4,000 per annum for 3 years has been received from the Government of Bombay, and another of Rs. 8,000 per annum for a like period from the Central Government. The Society's membership position will be reviewed by Government after 3 years and if inspite of all our efforts it continues to remain unsatisfactory they will decide whether to continue the subsidy or not. In the meantime it is comforting to feel that for the next 3 years at any rate the regular publication of the *Journal* is assured, and it is hoped that our membership position at the end of that period will show a substantial improvement.

Nature Education

Our thanks are due to the Government of Bombay also for sympathetic consideration of representations made to them in regard to the desirability of a nature education scheme in connection with the Natural History Section of the Prince of Wales Museum. Government have been pleased to sanction a sum of about Rs. 4,600 annually for 3 years in the first instance, towards the salary and expenses of the Nature Study Organiser appointed by the Society in February 1948 in anticipation of sanction. The account of the work done in this department during 1948 is given in the Annual Report.

During the period from January to July the museum nature education programme has been further expanded both in regard to activity with schools and with the general public. The Nature Education Organiser has for the last several months been giving popular talks on various natural history subjects every Sunday morning in English, followed in some cases with a repeat of the same in Gujarati and Marathi. Unfortunately the response from the public has so far been disappointing, but a progressive though slow increase of interest is becoming noticeable, and with persistence it is hoped to make these gallery talks a popular Sunday feature of the Natural History Section.

Conservation of Wild Life

The establishment of the so-called Kanheri National Park and of the Wild Life Sanctuary at Dandeli in Kanara District is a wise and farsighted step on the part of the Bombay Government, and is an earnest of the keen interest taken by our Premier in the matter of educational and recreational amenities for the ordinary citizen. The Society were invited to nominate a representative on the Directorate of Parks and Gardens. Mr. Humayun Abdulali,

the Society's nominee, has been particularly active in pleading the cause of wild life and in trying to bring about a total closure of shooting on the island of Salsette. He is also experimenting with the introduction of partridges, junglefowl, spurfowl, hares and the smaller deer into the park area so as to add to its natural attractions for visitors. If these animals are to thrive and increase, it is essential that all shooting and netting should be prohibited in the environs of the area, and adequate measures adopted to ensure that the restrictions are enforced and offenders strictly dealt with. The Society have recently attempted to move the police to prosecute several hotels and restaurants in the city which are brazenly advertising and selling partridge and other game birds during the close season. The police report that under the existing laws it is impossible to prosecute with any hope of conviction and it is apparent that the laws will have to be revised and brought into line with existing conditions.

The Government of Bombay have entrusted all matters in connection with wild life in the Province to the Director of Parks and Gardens jointly with the Chief Conservator of Forests, and our representative is busy revising the game laws so as to bring them in line with more progressive ones existing in other provinces, and in keeping with present day conditions, to ensure the preservation of our fast disappearing wild life.

At the invitation of the Government of Assam the Society deputed two of its members, Dr. Dillon Ripley and Mr. Sálim Ali to visit some of the rhinoceros and other wild life sanctuaries in that province and submit proposals for improving them and for making them more accessible and educative for local visitors, and an attraction for foreign tourists. The memorandum and suggestions of this commission, as amended and approved by our wild life experts, Mr. R. C. Morris and Lt.-Col. R. W. Burton, as well as by other competent sportsman and naturalist members resident in Assam has been submitted to the Assam Government with a request that they take early practical measures on the lines recommended in order to avert the fate towards which wild life is rapidly drifting.

In response to an invitation issued to the Society by the UNESCO to send a representative to the Technical Conference for the Protection of Nature to be held at Lake Success (U.S.A.) in August this year, our member Dr. Dillon Ripley has been requested to attend on behalf of the Society and move a resolution, if a suitable opportunity offers, enjoining on the Government of Assam to give effect to the Society's recommendations particularly in regard to the protection and preservation of the Great One-horned Rhinoceros.

The Honorary Secretary, Mr. Humayun Abdulali, announced the election of the following 103 members since the last meeting.

From 11th August 1948 to 31st December 1948

Mr. F. R. Danter, T.D.L. Association, Nasik; Dr. M. Sageer, Bombay; Mr. Nazar Futehally, Bombay; Shri B. K. Ghoshal, Director of Industries, Kanpur, U.P.; Shri Rameshwar Dayal,

Deputy Commissioner, Delhi; Shri A. Gupta, I.P., Saharanpur, U.P.; His Excellency Lt. General Sir Archibald Nye, G.C.S.I., G.C.I.E., K.C.B., K.B.E., M.C., New Delhi; Shri G. K. Handoo, I.P., New Delhi; Raja Shanker P. S. Deo, P.O. Chichli, via Godarwara; The Hon'ble Mr. Justice G. S. Rajadhyaksha, I.C.S., Bombay; Major C. R. Dotiwalla, I.A., Mhow Cantt., Madhya Bharat; The Bursar, Andhra Christian College, Guntur; Mr. K. Karunakaran Nair, M.SC., Bombay; Mr. R. S. Vatcha, Bombay; Lt.-Col. W. P. Horsburgh, c/o. Grindlays Bank Ltd., Bombay; Mr. K. P. Mathrani, I.C.S., Rajkot; Mr. D. R. Gadgil, Yerandawana, Poona; Mr. K. M. Kingaby, Bombay; Mr. A. S. Hinton, Milikajan P.O., & T.O., Assam; The Librarian, I.E.M.E.L. 32, Infantry Workshops, Amritsar; Mr. M. V. Pai, B.SC. (Econ.), Bhavnagar; Dr. M. G. Pradhan, Bombay; Dr. H. P. Moolgavkar, Bombay; Mr. S. Moolgavkar, Bombay; Mr. J. F. Dastur, M.SC., F.N.I., I.A.S. (Retd.), Bombay; Miss Nina Premchand, Bombay; Mr. L. G. O. Woodhouse, Ceylon; Mr. G. I. Lightle, Bombay; Sardar Gian Singh Rarevalla, B.A., Prime Minister of Patiala, Patiala; Mr. R. B. Das, Bombay; Mr. Sodhi Kartar Singh, P.O. Anandpur, District Hoshiarpur (E. Punjab); Prof. S. P. Agharkar, M.A., Ph.D., F.L.S., F.N.I., Poona; The Secretary, Board of Agriculture, Katmandu, Nepal; Mrs. Pott, Ootacamund, Nilgiris; Mr. W. W. Mayne, B.SC., Munnar P.O., Travancore; The Secretary, Kasturba Mahila Mandal, P.O. Kausani, District Almora; The Principal, Queen Mary's College, Madras; Mr. D. D. Watters, Bombay; Mr. S. H. Prater, O.B.E., C.M.Z.S., London; The Principal, St. Augustine's English School, Kalimpong, West Bengal; Mr. Behran Vicaji, Bandra, Bombay; Mr. S. P. Shahi, M.SC., A.I.F.C., Divisional Forest Officer, Ranchi; Dr. S. R. Captain, M.R.C.V.S., R.W.I.T.C., Bombay; The Director of Fisheries, Dundas Street, Karachi; The Mess President, Officers' Mess, Madras Regimental Centre, Nilgiris, S.I.; Kanwar Balram Singh, c/o Messrs. Balmer Lawrie & Co. Ltd., Calcutta; Mr. D. C. Matthai, c/o Messrs. McLeod & Co. Ltd., Calcutta; Mrs. John D. Fosque, c/o Caltex (India) Ltd., Bombay; The Principal, Agricultural College & Director, Agricultural Research Institute, Hebbal, Bangalore; Mr. A. Middleton, Aldur P.O., Mysore State; Mr. Geoffrey J. E. Percival, Norwood, Ceylon; Mr. F. E. G. Holton, Coimbatore, S.I.; Raja S. V. Jagannadha Rao, Raja Sahib of Jatprole, Kurnool District; Capt. M. J. Preston, Bangalore Cantonment; Mr. Elijah Nathan Elijah, Bombay; Mrs. Phiroza J. Taleyarkhan, Bombay; Dr. A. R. Ranjha, D.SC., c/o. The Zoological Survey and Marine Fisheries Department, Pakistan; The Officer-in-Charge, Zoological Survey and Marine Fisheries Department, Karachi; Mr. K. S. Lauly, B.SC. (Hons.), M.SC. (Tech.) Dandeli P.O., N. Kanara; Capt. W. S. Massey, North Wynaad, Malabar; Mr. L. F. P. Russell, Naharkatia P.O., Assam.

From 1st January to 4th August 1949

Mr. R. F. Elliott, Calcutta; Raja Bir Udit Pratap Sekhar Deo, Ruler, Gangpur, Jharsuguda; Dr. A. L. Furniss, Victoria Leprosy

Hospital, Hyderabad (Deccan); Major W. L. Roseveare, I.S.E. (Retd.), c/o. Lloyds Bank Ltd., London; Capt. A. R. Chowdhury, c/o. Agent, Imperial Bank, Dacca; Mr. W. J. Carrot, Burma Civil Service, Rangoon; Mr. C. N. Subramanian, Kadamane Estate, Saklaspur, Mysore; Miss K. A. D. Naoroji, Bombay; Mr. Saros A. D. Naoroji, Bhuj, Kutch; Mr. John Edge, E. Dooars, West Bengal; Mrs. D. D. Saini, Bombay; Mr. Hasanali K. Merchant, Agent, Standard Vacuum Oil Co., Bhavnagar; Mr. A. F. W. Humphreys, New Delhi; H.H. The Maharaja of Dhrangadhra, Dhrangadhra; Mr. M. A. Islam, Divisional Forest Officer, Gauhati, Assam; Mr. M. C. Jacob, Junior Conservator of Forests, Shillong, Assam; The Principal, Cotton College, Gauhati; Mr. S. C. Roy, Calcutta; Dr. De. V. Renato, Greens Hotel, Bombay; Mr. S. S. Dhareshwar, B.SC.,Chikodi, Belgaum; Mr. D. J. Wood, Cinnamara P.O., Assam; Mr. T. E. Sibbit, Rydak T. E., E. Dooars, Bengal; Mr. P. F. Cumberlege, c/o. Messrs. Burmah-Shell, Madras; Mr. Pratapsinh Karsondas Asar, Bombay; The Director, Pakistan Forest College, West Punjab, Pakistan; The Divisional Forest Officer, Poona; The Chief Conservator of Forests, United States of Rajasthan, Rajasthan, Kotah; The Director of Parks & Gardens, Bombay Province, Bombay; The Divisional Forest Officer, Kanara Eastern, Dharwar; Mr. A. E. G. Best, c/o. The Grahams Trading Co. (India) Ltd., Bombay; The Divisional Forest Officer, Satara; The Divisional Forest Officer, Nasik W.; Rev. Ernest M. Shull, Thana District; The Divisional Forest Officer, W. D. Kanara Dn., Karwar; The Divisional Forest Officer, North Khandesh Dn., Dhulia; Mr. Thakur Bhawani Singh, Jodhpur; Rev. L. E. Pocklington, Saranga P.O., W. Bengal; Mr. C. A. Caldeira, Canal Street, Calcutta; Mr. A. S. Talati, Dist. Chhindwara; The Divisional Forest Officer, Kanara Northern, Dharwar; Mr. Camar S. C. Tyabjee, Gunfoundry Road, Hyderabad Deccan; Mrs. Doris Ferreira, Bandra, Bombay.

LIABILITIES	Rs A P	Rs A P
Life Membership Fees :		85,790 0 0
Donations for specific purposes :		
From States for Survey Expenses (as per last Balance Sheet)		13,930 9 0
Sundry Creditors :		
For Printing, etc., of Journals ...	7,974 7 6	
,, ,, ,, of Circumventing the Mahseer and other Sporting Fish in India	3,703 0 0	
,, ,, ,, of Calendars ...	4,917 8 0	
,, *Expenses :* Royalties to Authors of Books ...	2,227 1 0	
Outstanding Creditors for Expenses (Audit Fee, Printing, Stationery, Sales Tax, etc).	399 8	
,, *Others :*		
Amount received in advance for Beautiful Indian Climbers and Shrubs	21 12 0	
		19,273 5 0
Suspense Account :		79 3 0
Surplus Account :		
Balance as per last Balance Sheet ...	52,240 13 5	
Less—Excess of Expenditure over income...	18,350 7 6	33,890 5 11
Total ...		1,52,932 13 11

ASSETS	Rs A P	Rs A P
Investments—At Holding value or Market value, whichever is lower :—		
Rs. 14,000 4% Bombay Port Trust Bonds.	10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...	11,400 0 0	
,, 35,000 3% Funding Loan 1966-68 ...	35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...	25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...	1,948 12 0	
Rs. 92,000 (Market value at 31st Dec. 1948 was Rs. 94,653-12-0).	84,941 6 0	
£450 3% Defence Bonds	6,133 5 4	
		91,074 11 4
Furniture :		
As per last Balance Sheet	1,690 0 0	
Additions during the year	46 15 0	
	1,736 15 0	
Less—Depreciation...	25 0 0	
		1,711 15 0
Sundry Debtors		6,655 4 3
Advance to the Staff		100 0 0
Advances for Publications :		
Poisonous Terrestrial Snakes of India, Burma and Ceylon (as per last Balance Sheet)	75 0 0	
Some Beautiful Indian Climbers and Shrubs	4,556 4 4	
Book of Indian Butterflies (as per last Balance Sheet)	697 7 6	
		5,328 11 10
Stock of Books, Calendars, etc., on hand (at cost) (as certified by the Secretary) :		
Book of Indian Birds—2,217 copies ...	12,748 0 0	
Book of Indian Animals—2,145 copies ...	12,602 0 0	
Circumventing the Mahseer and other Sporting Fish in India—811 copies ...	3,409 0 0	
Old Journals—12,330 copies	3,075 0 0	
Wild Life Calendars—115 Nos.... ...	158 0 0	
One full set of Journals series and one Jacka Mask	530 0 0	
Picture postcards—773 Sets	870 0 0	
Game Birds of India Vol. III Bound and unbound—480 Nos.	4,950 0 0	
		38,352 0 0
Cash—		
With National Bank of India, Ltd., Bombay	3,584 5 3	
With National Bank of India, Ltd., London, £433-3-10	5,775 14 3	
On hand	350 0 0	
		9,710 3 6
Total ...		1,52,932 13 11

Note.—A stock of valuable research collection and Library Volumes have not been taken into account on the Assets side of the Balance Sheet.

We have prepared the above Balance Sheet from the books of account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion, such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *6th May, 1949*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants
Registered Accountants } AUDITORS.

BOMBAY NATURAL HISTORY SOCIETY

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1948* Cr.

EXPENDITURE	Rs A P	Rs A	INCOME	Rs A P	Rs A P
			By Subscriptions		19,602 3 7
To Salaries (including Dearness Allowance)		36,045 1 0	,, Entrance Fees		1,340 5 4
,, Contribution to Staff Provident Fund ...		1,272 7 0	,, Sales of :		
,, Cost of Printing, etc., of Journal ...		11,925 2 10	Journals	2,451 2 2	
,, Rent		1,680 0 0	Society's Publications	129 13 3	
,, General Charges		1,179 4 3			2,580 15 5
,, Stationery and Printing (Rs. 135-14-0 on account of Wild Life Conservation Propaganda)		814 7 3	,, Profit on Sales of :		
			Game Birds of India, Vol. III.. ...	8 12 0	
			Book of Indian Birds	1,907 11 2	
			,, ,, Animals	4,289 14 4	
			Circumventing the Mahseer and other Sporting Fish in India	709 13 3	
			Bird Picture Postcards	240 7 9	
			Wild Life Calendars	2,335 6 3	
					9,492 0 9
,, Postage		2,056 1 6	,, Interest on Investments		3,733 7 0
,, Library		686 12 3	,, Sundries :—		
,, Fire Insurance		170 0 0	Profit on outside work	124 5 6	
,, Audit Fee		250 0 0	,, ,, sale of Securities ...	770 10 0	
,, Bad Debts		42 11 0	Advertisements in Journals	152 8 0	
,, Depreciation on Furniture		25 0 0			1,047 7 6
			,, Excess of Expenditure over Income Transferred to Balance Sheet		18,350 7 6
Total ...		56,146 15 1	Total ...		56,146 15 1
Game Birds of India Vol. III					
To Stock on 1st January, 1948 Bound Copies	1,056 0 0		By Sales during the year		200 12 0
,, Stock on 1st January, 1948 Unbound Copies	4,000 0 0		,, Stock on 31st December, 1948 Bound Copies	960 0 0	
		5,056 0 0	,, Stock on 31st December, 1948 Unbound Copies	4,000 0 0	4,960 0 0
,, Royalties to Author		78 9 0			
,, Sundry Charges—Packing, etc.		17 7 0			
,, Profit transferred to Income and Expenditure Account		8 12 0			
Total ...		5,160 12 0	Total ...		5,160 12 0
Book of Indian Birds, 4th Edition					
To Stock on 1st January, 1948		15,876 0 0	By Sales during the year		6,477 3 5
,, Royalties to Author		1,253 0 0	,, Stock on 31st December, 1948		12,748 0 0
,, Sundry Charges—Packing, etc.		188 8 3			
,, Profits transferred to Income and Expenditure Account		1,907 11 2			
Total ...		19,225 3 5	Total ...		19,225 3 5

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1948—(continued.) *Cr.*

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Book of Indian Animals					
To Cost of Printing and Publishing 3,000 Copies		17,682 12 9	By Sales during the year		10,691 8 4
,, Royalties to Author		642 0 0	,, Stock on 31 December, 1948		12,602 0 0
,, Sundry Charges—Packing, etc.		678 13 3			
,, Profit transferred to Income and Expenditure Account		4,289 14 4			
Total ...		23,293 8 4	Total ...		23,293 8 4
Circumventing the Mahseer and Other Sporting Fish in India					
To Cost of Printing and Publishing 1,000 Copies		4,245 13 6	By Sales during the year		2,138 1 6
,, Royalties to Author		253 8 0	,, Stock on 31st December, 1948		3,409 0 0
,, Sundry Charges—Packing etc.		337 14 9			
,, Profit transferred to Income and Expenditure Account		709 13 3			
Total ...		5,547 1 6	Total ...		5,547 1 6
Picture Post-Cards					
To Cost of Printing and Publishing 1,000 sets		1,122 6 0	By sales during the year		525 12 9
,, Sundry Charges—Packing, etc.		32 15 0	,, Stock an 31st December, 1948		870 0 0
,, Profit transferred to Income and Expenditure Account		240 7 9			
Total ...		1,395 12 9	Total ...		1,395 12 9
Calendars					
To Stock on 1st January, 1948		18 12 0	By Sales during the year		7,734 10 0
,, Cost of Printing, etc.		4,995 8 0	,, Stock on 31st December, 1948		158 0 0
,, Sundry Charges—Packing, etc.		542 15 9			
,, Profit transferred to Income and Expenditure Account		2,335 6 3			
Total ...		7,892 10 0	Total ...		7,892 10 0

BOMBAY, *6th June, 1949.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants,
Registered Accountants, } AUDITORS.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE LECTURE ROOMS OF THE B.E.S. & T. COMMITTEE, ELECTRIC HOUSE, ORMISTON ROAD, BOMBAY, ON THURSDAY THE 4th AUGUST 1949, AT 6 P.M.

1. The Managing Committee's Report for the year ended 31st December 1948 having been circulated among members was taken as read.

2. The Honorary Secretary read a supplementary report on the activities of the Society during the current year and again stressed the need for increased membership. (for details see p. 622)

3. When presenting the accounts the Honorary Treasurer explained that a saving of approximately Rs. 16,000 will be effected this year as the final instalment of gratuities had been paid off to members of the staff who had recently retired after long service.

4. The Executive and Advisory Committees for 1949 as previously proposed in the circular to members were duly elected, there being no fresh nominations received.

5. The Honorary Secretary asked for suggestions from the members present for popularising and adequately publicizing the activities of the Society. Several members expressed their views:

Fr. H. Santapau suggested that we should have monthly meetings where contributors of small papers to the *Journal,* for example the various miscellaneous notes, should present their observations in person as far as possible, initiating discussion and bringing about closer contact between members.

Dr. S. L. Hora expressed a similar opinion and the Honorary Secretary promised to try and arrange for such meetings in Bombay.

On the termination of the formal meeting, members and their friends attended an absorbing talk by Dr. S. L. Hora, the Director of the Zoological Survey of India on his Satpura Hypothesis of Indo-Malayan animal distribution (illustrated with lantern slides). This was followed by a film entitled 'Poultry: A Billion Dollar Industry' which was very kindly lent for the occasion by the United States Information Service.

CATALOGUE OF BOOKS IN THE BOMBAY NATURAL HISTORY SOCIETY'S LIBRARY

Part III—Reptiles, Amphibians & Fishes

R—Reptiles.

A—Amphibians.

P—Fish and Fisheries.

Ps = Fish—Sport and Angling.

RPr = Reptiles—Popular.

RFR = Fauna of British India Series (Reptiles & Amphibians).

PFR = do. do. (Fish). Reference volumes ; not lent out.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
					Adamson, Hans Christian	(*See* Carnochan, F. G. & Adamson, Hans Christian.)
1	R	51	5	F	Anderson, John	Reptilia & Batrachia—Zoology of Egypt, Vol. I, 1898.
2	R	30	5	A	Anonymous	Ophiolatreia : An Account of the Rites & Mysteries connected with the Origin, Rise and Development of Serpent Worship, and a full description of the Celebrated Serpent Mounds & Temples—(Privately printed).
3	R	27	5	A	Berridge, W. S.	All about Reptiles & Batrachians, 1935.
4	R	41	5	A	do.	Marvels of Reptile Life, 1926.
5	R	1	5	A	Boulenger, George Albert	Monograph of the Lacertidae, Vol. I, 1920.
6	R	2	5	A	do.	Monograph of the Lacertidae, Vol. II, 1921.
7	R	3	5	A	do.	Catalogue of the Lizards in the British Museum (Nat. History), Geckonidae, Eublepharidae, Uroplatidae, 2nd Edn., Vol. I, 1885.
8	R	4	5	A	do.	Catalogue of the Lizards in the British Museum (Nat. History), Iguanidae, Xenosauridae, Zonuridae, Anguidae, Anniellidae, Helodermatidae Varanidae, Xantusiidae, Teiidae, Amphisbaenidae, Vol. II, 1885
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Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
10	R	6	5	A	Boulenger, George Albert	CATALOGUE OF THE SNAKES IN THE BRITISH MUSEUM (Nat. History), Typhlopidae - Colubridae, Vol. I, 1893.
11	R	7	5	A	do.	CATALOGUE OF THE SNAKES IN THE BRITISH MUSEUM (Nat. History), Colubridae, Aglyphae, Vol. II, 1894.
12	R	8	5	A	do.	CATALOGUE OF THE SNAKES IN THE BRITISH MUSEUM (Nat. History), Colubridae (Opisthoglyphae & Proteroglyphae), Amblycephalidae & Viperidae, Vol. III, 1896.
13	R	9	5	A	do.	CATALOGUE OF THE CHELONIANS RHYNCOCEPHALIANS & CROCODILES IN THE BRITISH MUSEUM (Nat. History), New Edition, 1889.
14	RFR	45	5	A	do.	REPTILIA AND BATRACHIA—A VERTEBRATE FAUNA OF THE MALAY PENINSULA from the Isthmus of Kra to Singapore including the adjacent Islands, 1912.
15	RFR	52	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Lizards—Reptilia & Batrachia, 1890.
16	RFR	53	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Snnkes, 1890.
17	RFR	54	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Frogs, 1890.
18	RFR	55	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Crocodiles, Tortoises & Lizards, 1890.
19	RFR	56	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Snakes, 1890.
20	RFR	57	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Reptilia & Batrachia, 1890.
21	RFR	66	7	C	do.	THE FAUNA OF BRITISH INDIA INCLUDING BURMA & CEYLON, Crocodiles & Tortoises—Reptilia & Batrachia, 1890.
22	R	19	5	A	Bourret, Rene	LES SERPENTS DE L'INDOCHINE—Etudes sur la Faune—Tome I, 1936.
23	R	20	5	A	do.	LES SERPENTS DE L'INDOCHINE, Etudes sur la Faune—Tome II, 1936.
24	R	13	5	A	Broom, Robert	THE MAMMAL-LIKE REPTILES OF SOUTH AFRICA & THE ORIGIN OF MAMMALS, 1932.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
					Brunton, Sir Lauder	(*See* Fayrer, Sir Joseph, Brunton, Sir Lauder, & Rogers, Major Leonard.)
					Caius, R. P. F.	(*See* Phisalix, Marie & Caius, R.P.F.)
25	RPr	22	5	A	Carnochan, F. G. & Adamson, Hans Christian	The Empire of the Snakes, 1935.
26	R	32	5	A	Cazalay, Major W. H.	The Common Snakes of India & Burma & How to Recognize them, 1914.
27	R	37	5	A	Corkill, Norman L.	Snakes & Snake Bite in Iraq—A Handbook for Medical Officers. Royal College of Medicine of Iraq publication, 1932.
28	R	12	5	A	Derinayagala, P E P.	The Tetrapod Reptiles of Ceylon—Testudinates & Crocodilians, *Ceylon Journal of Science*-(Colombo Museum Natural History Series), 1939.
29	R	11	5	A	Ditmars, Raymond L.	Snakes of the World, 1937.
30	R	29	5	A	Fayrer, Sir Joseph, Brunton, Sir Lauder, Rogers, Major Leonard	On the Poison of Venomous Snakes & the Method of preventing Death from their Bite, 1909.
31	R	46	5	F	Fayrer, J.	The Thanatophidia of India, being a description of the Venomous Snakes of the Indian Peninsula, with an account of the influence of their poison on Life; and a series of experiments, 1872.
32	R	64	5	F	do.	The Thanatophidia of India, being a description of the Venomous Snakes of the Indian Peninsula, with an account of the influence of their poison on Life; and a series of experiments, 1872.
33	R	28	5	A	Fitzsimons, F. W.	Pythons & Their Ways, 1930.
34	R	18	5	A	Fitzsimons, Vivian F.	The Lizards of South Africa—Transvaal Museum Memoir No. 1, 1943.
35	R	36	5	A	Garcia, Evaristo	Los Ofidios Venenosos del Cauca Metodos Empiricos y Racionales Empleados Contra los Accidentes producidos por la Mordedura de Esos Reptiles, 1896.
36	R	31	5	A	Gharpurey, Lt.-Col. K. G.	The Snakes of India, 1935.
37	R	65	5	A	Giboin, Le Pharmacien Commandant Lucien.	L Principaux Serpents de l'Inde, Premiere Edition, 1948.
38	R	50	5	F	Gunther, Albert C. L. G.	The Reptiles of British India—The Ray Society—1864.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
39	R	42	5	A	Kinghorn, J. R.	Snakes of Australia, 1929.
40	R	43	5	A	do.	do.
41	R	44	5	A	do.	do.
42	R	48	5	F	Lamb, Capt. George	The Specificity of Antivenomous Sera, with Special Reference to a Serum prepared with the Venom of *Daboia russellii* (*Vipera russellii*)—Scientific Memoirs by the Officers of the Medical & Sanitary Department of the Government of India. New Series—No. 16, 1905.
43	R	49	5	F	do.	Snake-Venoms in relation to Haemolysis. Scientific Memoirs by Officers of the Medical & Sanitary Departments of the Government of India. New Series—Nov. 17, 1905.
					Leonard, Major Rogers	(*See* Joseph, Sir, Fayrer, Lauder, Sir, Brunton, Leonard, Major, Rogers.
44	R	39	5	A	Mathew, W. D.	Dinosaurs, with special reference to the American Museum collections—American Museum of Natural History, 1915.
45	R	24	5	A	Nicholson, Edward	Indian Snakes, An Elementary Treatise on Ophiology, with a Descriptive Catalogue of the Snakes found in India & the adjoining countries, 2nd Edition, 1893.
46	R	25	5	A	do.	do.
47	R	15	5	A	Phisalix, Marie	Animaux Venimeux et Venins, Tome i, 1922.
48	R	16	5	A	do.	Animaux Venimeux et Venins, Tome ii, 1922.
49	R	21	5	A	Phisalix, Marie & Caius, R. P. F.	Snake Venoms—Reprints from Journal et de Pathologie Generale Extrait du Tome xvii 1917-1918 and other Reprints on the subject from the Indian Journal of Medical Research, under the joint authorship of Caius, R.P.F., Anderson, Major, L.A.P., Iyyengar, Capt. K.R.K. & Steichen, Rev. Fr. A., 1923-1925.
50	R	14	5	A	Pitman, Capt. Charles R. S.	A Guide to the Snakes of Uganda, 1938.
51	R	10	5	A	Pope, Clifford H.	The Reptiles of China—Natural History of Central Asia, Vol. x (Central Asiatic Expedition), 1935.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
52	R	40	5	A	Prater, S. H.	THE SNAKES OF BOMBAY ISLAND & SALSETTE, illustrated by 6 plates & a text-figure—Prince of Wales Museum (Natural History Section)—Reprinted from the *J. B. N. H. S.* Vol. XXX, 1925. 2nd Edition, 1926.
53	R	66	6	A	Russell, Patrick	A CONTINUATION OF AN ACCOUNT OF INDIAN SERPENTS ; containing descriptions & figures, from specimens and drawings, transmitted from various parts of India, Vol. II, Part I, 1801.
54	R	67	6	A	do.	A CONTINUATION OF AN ACCOUNT OF INDIAN SERPENTS ; containing descriptions & figures, from specimens and drawings, transmitted from various parts of India, Vol. II, Part 2, 1801.
					Schlegel, H.	(*See* Siebold, PH. Fr. D. C., Temminck, C. J. & Schlegel, H.)
55	R	38	5	A	Sclater, W. L.	LIST OF SNAKES IN THE INDIAN MUSEUM, 1891.
56	R	68	6	A	Siebold, PH. Fr. D. C., Temminck, C. J. & Schlegel, H.	REPTILIA—Fauna Japonica, 1838.
57	R	26	5	A	Smith, Malcolm	MONOGRAPH OF THE SEA-SNAKES (*Hydrophiidae*)—The British Museum (Natural History), 1926.
58	RFR	58	7	A	Smith, Malcolm A.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Loricata, Testudines—Reptilia & Amphibia, Vol. I, 1931.
59	RFR	59	7	A	do.	THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON & BURMA, Sauria, Vol. II, 1935.
60	RFR	60	7	A	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Serpentes, Vol. III, 1943.
61	RFR	61			do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Loricata, Testudines Reptilia & Amphibia, Vol. I, 1931.
62	RFR	62			do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Sauria, Vol. II, 1935.
63	RFR	63			do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA, Serpents, Vol. III, 1943.
					Temminck, C. J.	(*See* Siebold, Ph. Fr. D. C., Temminck, C. J. & Schlegel, H.)
64	R	17	5	A	Wall, Major F.	A POPULAR TREATISE ON THE COMMON INDIAN SNAKES, illustrated by coloured plates & diagrams (Reprinted from papers published in Vols. XVI—XXVI, 1905-1919.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
65	R	23	5	A	do.	OPHIDIA TAPROBANICA or The Snakes of Ceylon, 1921.
66	R	33	5	A	do.	THE POISONOUS TERRESTRIAL SNAKES OF OUR BRITISH INDIAN DOMINIONS & How to Recognize them (Reprinted with additions and corrections from papers which appeared in Vol. xvii of the *J.B.N.H.S.* 1907.
67	R	34	5	A	do.	do.
68	R	35	5	A	do.	A HANDLIST OF THE SNAKES OF THE INDIAN EMPIRE (Reprinted from papers published in Vols. xxix & xxx of the *J.B.N.H.S.*), 1923-1925.
					AMPHIBIANS	
1	A	3	5	A	Bourret, R.	LES BATRACIENS DE L' INDOCHINE 1941.
2	A	1	5	A	Parker, H. W.	A MONOGRAPH OF THE FROGS OF THE FAMILY MICROHYLIDAE, 1934.
3	A	2	5	A	Sclater, W. L.	LIST OF THE BATRACHIA IN THE INDIAN MUSEUM, 1892.
					FISHES	
1	P	53	5	C	Agricultural Marketing Adviser to the Government of India, The	PRELIMINARY GUIDE TO INDIAN FISH, FISHERIES, METHODS OF FISHING & CURING—Agricultural Marketing in India—Marketing Series No. 24, 1941.
					Bacon, Alban	(*See* Taverner, Eric, Nall, G. Herbert & Bacon, Alban.)
					Bean, Tarleton H.	(*See* Goode, George Brown & Bean, Tarleton H.)
2	P	22	5	B	Beavan, Capt. R.	HANDBOOK OF THE FRESHWATER FISHES OF INDIA, 1877.
3	P	83	5	C	do.	HANDBOOK OF THE FRESHWATE FISHES OF INDIA, giving the characteristic peculiarities of all the species at present known, & intended as a Guide to Students & District Officers, 1877.
4	P	59	5	C	Beebe, William	HALF MILE DOWN, 1935.
5	Ps	71	5	C	Bhattacharyya, P. N.	HINTS TO AMATEURS ON TANK ANGLING IN INDIA, 1915.
6	P	25	5	B	Boulenger, E. G.	THE AQUARIUM BOOK, 1925.
7	P	1	5	B	Boulenger, George Albert	CATALOGUE OF THE FRESHWATER FISHES OF AFRICA IN THE BRITISH MUSEUM (Natural History.), Vol. I, 1909.
8	P	2	5	B	do.	do. Vol. II, 1911.
9	P	3	5	B	do.	do. Vol. III, 1915.
10	P	4	5	B	do.	do. Vol. IV, 1916.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
11	P	31	5	B	Bowers, George M.	ARTIFICIAL PROPAGATION OF THE SALMONS OF THE PACIFIC COAST —extracted from the revised edition of the Fish Manual. pp. 1-15, plates 3-10. U.S. Commission of Fish & Fisheries, 1903.
12	P	34	5	B	do.	BULLETIN OF THE BUREAU OF FISHERIES—Department of Commerce & Labour—Vol. XXVIII, Part I, 1908, 1910.
13	P	35	5	B	do.	BULLETIN OF THE BUREAU OF FISHERIES—Department of Commerce & Labour—Vol. XXVIII, Part II, 1908, 1910.
14	P	74	5	F	Brough, James	THE TRIASSIC FISHES OF BESANO, LOMBARDY—British Museum (Nat. History), 1939.
15	P	90	5	C	Bruning, Christian	ICHTHYOLOGISCHER BILDERATLAS, 1929.
16	Ps	69	5	C	Buckland, Frank	LOG-BOOK OF A FISHERMAN & ZOOLOGIST, 1883.
					Bushman, J. S.	(*See* Jardine, Sir William & Bushman, J. S.)
17	P	44	5	C	Campbell, The Hon'ble, A. Y. G. & Nicholson, Sir F.A.	ADMINSTRATION REPORT, 1919-20 & Remarks on Canning & Manufacture of Fish Oil & Guano—Reports 1, 2 & 3 of 1921, Madras Fisheries Department Bulletin, No. 13, 1922.
					Chaudhuri, B. L.	(*See* Sewell, R. B. Seymour & Chaudhuri, B.L.)
					Chidambaram, K.	(*See* Devanesen, Rao Sahib, D. W. & Chidambaram, K.)
18	Ps	84	5	C	Clifford, George	FISHING—COMPASS BOOK No. 6, 1948.
					Cretin, E.	(*See* Lacy, G. H. & Cretin, E.)
19	P	24	5	B	Daniel, J. Frank	THE ELASMOBRANCH FISHES, 1922.
20	P	75	5	F	Day, Francis	THE FISHES OF INDIA being a Natural History of the Fishes known to inhabit the Seas & Freshwaters of India, Burma & Ceylon, Vol. I, Text, including Supplement, 1878-88.
21	P	76	5	F	do.	THE FISHES OF INDIA being a Natural History of the Fishes known to inhabit the Seas & Freshwaters of India, Burma & Ceylon, Vol. II, Atlas—containing 198 plates, 1878-1888.
22	P	79	5	F	do.	THE FISHES OF MALABAR, 1865.
23	PFR	88	7	A	do.	THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON & BURMA, Fishes, Vol. I, 1889.
24	PFR	89	7	A	do.	THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON & BURMA, Fishes, Vol. II, 1889.

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25	P	80	5	F	De, Kiran Chandra	REPORT ON THE FISHERIES OF EASTERN BENGAL & ASSAM, 1910.
26	P	92	5	C	Devanesen, Rao Sahib D. W. & Chidambaram, K.	THE COMMON FOOD-FISHES OF THE MADRAS PRESIDENCY—Dept. of Industries & Commerce, Madras, 1948.
27	P	77	5	F	Goode, George Brown & Bean, Tarleton H.	OCEANIC ICHTHYOLOGY, a treatise on the deep-sea & pelagic fish of the world based chiefly upon the collections made by the steamers Blake, Albatross & Fish Hawk in the Northern Atlantic, with an atlas containing 417 figures—Special Bulletin, Smithsonian Institution, U. S. National Museum, 1895.
28	P	40	5	C	Govindan, V.	FISHERY STATISTICS & INFORMATION, WEST & EAST COASTS, Madras Presidency—Madras Fisheries Bureau, Bulletin No. 9, 1916.
29	P	5	5	B	Gunther, Dr. Albert	CATALOGUE OF THE ACANTHOPTERYGIAN FISHES IN THE COLLECTION OF THE BRITISH MUSEUM—Gasterosteidae, Berycidae, Percidae, Aphredoderidae, Pristipomatidae, Mullidae, Spridae—Vol. I, 1859.
30	P	6	5	B	do.	CATALOGUE OF THE ACANTHOPTERYGIAN FISHES IN THE COLLECTION OF THE BRITISH MUSEUM—Squamipinnes, Cirrhitidae, Triglidae, Trachinidae, Sciaenidae, Polynemidae, Sphraenidae, Trichiuridae, Scombridae, Carangidae, Xiphiidae—Vol. II, 1860.
31	P	7	5	B	do.	CATALOGUE OF THE ACANTHOPTERYGIAN FISHES IN THE COLLECTION OF THE BRITISH MUSEUM–Gobiidae, Discoboli, Oxudercidae, Batrachidae, Pediculati, Blenniidae, Acanthoclinidae, Comephoridae, Trachypteridae, Lophotidae, Tenthididae, Acronuridae, Hoplognathidae, Malacanthidae, Nandidae, Polycentridae, Labyrinthici, Luciocephalidae, Atherinidae, Mugilidae, Ophiocephalidae, Trichonotidae, Cepolidae, Gobiesocidae, Psychrolutidae, Centriscidae, Fistularidae, Mastacembelidae, Notacanthi—Vol. III, 1861.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
32	P	8	5	B	Gunther, Dr. Albert	CATALOGUE OF THE ACANTHOPTERYGII, PHARYNGOGNATHI AND ANACANTHINI IN THE COLLECTION OF THE BRITISH MUSEUM, Vol. IV, 1862.
33	P	9	5	B	do.	CATALOGUE OF THE PHYSOSTOMI, IN THE COLLECTION OF THE BRITISH MUSEUM containing the families Siluridae, Characinidae, Haplochitonidae, Sternoptychidae, Scopelidae, Vol. V, 1864.
34	P	10	5	B	do.	CATALOGUE OF THE PHYSOSTOMI, contd., containing the families Salmonidae, Percopsidae, Galaxidae, Mormyridae, Gymnarchidae, Esocidae, Umbridae, Scombresocidae, Cyprinodontidae, Vol. VI, 1866.
35	P	11	5	B	do.	CATALOGUE OF THE PHYSOSTOMI, contd., Heteropygii, Cyprinidae, Gonorhynchidae, Hyodontidae, Osteoglossidae, Clupeidae, Chirocentridae, Alepocephalidae, Notopteridae, Halosauridae, Vol. VII, 1868.
36	P	12	5	B	do.	CATALOGUE OF THE PHYSOSTOMI, contd., Gymnotidae, Symbranchidae, Muraenidae, Pegasidae and families of the Lophobranchii, Plectognathi, Dipnoi, Ganoidei, Chondropterygii, Cyclostomata, Leptocardii, Vol. VIII, 1870.
37	P	13	5	B	do.	CATALOGUE OF THE PERCIFORM FISHES IN THE BRITISH MUSEUM-Centrarchidae, Percidae and Serranidae (part), Vol. I, 2nd Edition, 1895.
38	P	21	5	B	Gunther, Albert C. L. G.	AN INTRODUCTION TO THE STUDY OF FISHES, 1880.
					do.	(*See* Playfair, Lt.-Col. R. Lambert & Gunther, Albert C. L. G.)
					Hamilton, R.	(*See* Jardine, Sir William & Hamilton, R.)
39	Ps	67	5	C	Hedges, F. A. Mitchell	BATTLES WITH GIANT FISH, 4th Edition, 1926.
40	P	52	5	C	Hefford, A. F.	REPORT ON THE WORK OF 'WILLIAM CARRICK', 1923.
41	P	37	5	B	Hornell, James	MADRAS FISHERY INVESTIGATIONS —Madras Fisheries Bureau, Bulletin No. 4, 1910.
42	P	38	5	B	do.	MARINE FISH-FARMING FOR INDIA —Madras Fisheries Bureau, Vol. II, Bulletin No. 6, 1911.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
43	P	39	5	C	Hornell James	Marine Fishery Investigations in Madras 1914-15—Madras Fishery Department, Bulletin No. 8, 1916.
44	P	42	5	C	Hornell, James, Nicholson, Sir F. A. & Wilson, H.C.	The Edible Molluscs of the Madras Presidency; A New Protozoan cause of mortality among Marine Fishes; The Fishing Industry of Tuticorin; The Indian Beche-de-mer Industry; Carp Growing in Germany; Treatment of Swamps and other Mosquito-infested Areas—Madras Fisheries Department, Builetin No. 11, 1918.
45	P	43	5	C	Hornell, James, Nayudu, M. Ramaswami, Wilson, H. C. & Panikkar, N. P.	Administration Report, 1918-1919, and The Outrigger Canoes of Indonesia—A Statistical Analysis of an Inshore Fishing Experiment at Madras, 1919; Reports of the Fisheries of the Nilgiris; Notes on the Cichlid Fishes of Malabar, Madras Fisheries Department, Bulletin No. 12, 1921.
46	P	45	5	C	Hornell, James	Madras Fishery Investigations, 1921 (Second Series)—Madras Fisheries Department, Bulletin Vol. XIV, 1922.
47	P	46	5	C	do.	The Indian Pearl Fisheries of the Gulf of Mannar & Palk Bay—Madras Fisheries Department, Bulletin, Vol. XVI, 1922.
48	P	48	5	C	do.	Administration Report, 1922-23 & The Fishing Methods of the Madras Presidency, Part I. Coromandel Coast, Reports Nos. 1 & 2 of 1924, Madras Fisheries Department, Bulletin No. 18, 1927.
49	P	55	5	C	do.	The Fishing Methods of the Madras Presidency, Madras Fisheries Department, Part II—The Malabar Coast; Report No. 1 of 1937, Madras Fisheries, Bulletin, Vol. XXVII, 1938.
50	P	57	5	C	Hornell, James, & Nayudu, M. Ramaswami	The Flying-fish Fishery of Coromandel Coast & The Spawning Habits of Cypsilurus & a Note on the Eggs & the early embryonic development—Madras Fisheries Department, Report No. 4 of 1922, Madras Fisheries, Bulletin, Vol. XV, pp. 99-112, 1923.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
51	P	26	5	B	Innes, William T.	EXOTIC AQUARIUM FISHES, A work of general reference, 2nd Edition, 1935.
52	P	14	5	B	Jardine, Sir William & Bushman, J. S.	ICHTHYOLOGY, Fishes particularly their structure & economic uses, The Naturalist's Library, Vol. XXXV, 1853.
53	P	15	5	B	Jardine, Sir William & Hamilton, R.	ICHTHYOLOGY: BRITISH FISHES, Part I, Vol. XXXVI, 1852.
54	P	16	5	B	do.	ICHTHYOLOGY: BRITISH FISHES, Part II, Vol. XXXVII, 1854.
55	P	17	5	B	Jardine, Sir William	ICHTHYOLOGY: FISHES OF THE PERCH FAMILY, Vol. XXXVIII, 1852.
56	P	18	5	B	Jardine, Sir William & Schomburgk, R. H.	ICHTHYOLOGY: FISHES OF BRITISH GUIANA, Part II, Vol. XL, 1852.
57	P	28	5	B	Jones, Thomas Rymer	THE AQUARIAN NATURALIST, A Manual for the Sea-side, 1858.
58	P	23	5	B	Jordon, David Starr	FISHES, 1925.
59	P	19	5	B	Kyle, Harry M.	THE BIOLOGY OF FISHES, 1926.
60	P	20	5	B	do.	do.
61	Ps	65	5	C	Lacy, G. H. & Cretin, Dr. E.	ANGLER'S HANDBOOK, North Punjab Fishing Club, 3rd Edition, 1895.
62	P	29	5	B	Lowe, Richard Thomas	A HISTORY OF THE FISHES OF MADEIRA, 1843-'60.
63	Ps	85	5	C	Macdonald, A. St. J.	CIRCUMVENTING THE MAHSEER & OTHER SPORTING FISH IN INDIA & BURMA, 1948.
64	Ps	70	5	C	Manley, J. J.	NOTES ON FISH & FISHING, 1877.
					Masterman, Arthur Thomas	(*See* McIntosh, William Carmichael & Masterman, Arthur Thomas.)
65	Ps	72	5	C	Masters, John	THE COMPLEAT INDIAN ANGLER, 1938.
66	P	25	5	B	McIntosh, William Carmichael & Masterman, Arthur Thomas	THE LIFE-HISTORIES OF THE BRITISH MARINE FOOD-FISHES, 1897.
					Nall, G. Herbert	(*See* Taverner, Eric, Nall, G. Herbert & Bacon, Alban.)
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67	P	32	5	B	Nicholson, Sir F. A.	NOTES ON FISHERIES IN JAPAN, 1907.
68	P	36	5	B	do.	Papers from 1899 relating chiefly to the development of Madras Fisheries Bureau, Vol. I, Bulletin No. 1, 1915.
69	P	41	5	C	do.	ANNUAL REPORTS of the Madras Fisheries Bureau 1908-1917—Madras Fisheries Bureau Bulletin No. 10 (Part II of Bulletin No. 1), 1918.
					do.	(*See* Campbell, The Hon'ble, A. Y. G. & Nicholson, Sir F.A.)
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Serial No.	Classification	Accession No	Cabinet	Shelf	Author	Title of Book
70	P	81	5	C	Norman, J. R.	A Systematic Monograph of The Flat Fishes (Heterosomata)—Psettodidae, Bothidae, Pleuronectidae—Vol. I, 1934.
71	P	82	5	C	do.	A History of Fishes, 3rd Edition, 1947.
					Panikkar, N. P.	(*See* Hornell, James, Nayudu, Ramaswami M., Wilson, H. C. & Panikkar, N. P.)
72	P	78	5	F	Playfair, Lt. Col. R. Lambert, & Gunther, Albert C. L. G. Prater, S. H.	The Fishes of Zanzibar. Acanthopterygii & Pharyngognathi, etc., 1866. (*See* Spence, Sir Reginald & Prater, S. H.)
73	P	93	5	C	Rachow, A.	Tropical Aquaria Fish Catalogue, 1927.
74	P	94	6	A	Russell, Patrick	Descriptions and Figures of two hundred Fishes collected at Vizagapatam on the coast of Coromandel, Vol. I, 1803.
75	P	95	6	A	do.	do. Vol. II, 1803.
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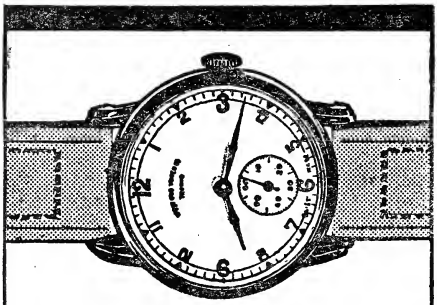

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JUNGLE MEMORIES

BY

LT.-COL. E. G. PHYTHIAN-ADAMS, O.B.E., F.Z.S., I.A. (Retd.).

PART IV—WILD DOGS AND WOLVES, ETC.

The epithet, 'a perfect swine' may with every justification be applied to the Wild Dog, whose nature and habits may be summed up in a single word—bloody. These have been so fully described by Lt.-Col. R. W. Burton in the *Journal* of the Society for August 1940, that this account of personal experiences is little more than supplementary to the details given in that article.

Shikar books rightly emphasise the importance of taking every opportunity of destroying these pests of the jungle, not only on account of the immense destruction they cause to game, but for the more sordid reason that their skins carry a handsome Government reward. These facts are so well known that one might expect every sportsman to be aware of them, and yet I have it on the best authority that when two young officers came across a pack in the Nilgiris only last year, they did not know what they were, and refused to believe the shikari's assurance regarding the Government reward. All of which goes to show how ignorant some of the younger generation are of natural history, and how important it is that they should become members of our Society!

In my own case I read up all I could about wild dogs as soon as I reached this country, and have never lost a chance of shooting them. I have kept no record of the number destroyed, but it cannot be far short of 50, as I have constantly come across them in the Nilgiris, both on the plateau and in the low country, and have seldom failed to take toll.

Early Experiences

The first pack I came across was in Chanda in 1907 when I was after bison. We had found fresh tracks of the latter and a few minutes afterwards a cow dashed away through the bamboos. It was the first bison I had seen so I followed, and almost at once found a pack of from 12 to 16 wild dogs in a great state of excitement. I shot the leader as he sat and looked at me, and the rest bolted 'snarling and yapping', according to my diary. Whether they were actually after the bison I cannot say, but my trackers were positive about it.

My next experience was in the ghats west of Poona where I was tying up at night for panther. Creeping up quietly at dawn, I found the goat on the ground bleating feebly, with a pack of 6 wild dogs on it. Some quick shooting killed two on the spot and wounded two more which were found dead later. The goat had one ear eaten off, a piece of skin about 4 inches in diameter bitten out of its side and in addition a foot was chewed. Evidently the pack's arrival had almost coincided with my own. Of the survivors one kept calling for a couple of days after—'a long moaning whine very hard to describe.' Unfortunately I did not then know the dodge of answering with 3 toots on a fired rifle cartridge case.

Wild Dogs and Monkeys

Later in the same year (1909) I was in camp at Virnoli in North Canara, and one afternoon while I was having tea, heard monkeys cursing some 200 yards away. I went out to investigate, and found two wild dogs lying in the middle of the road looking up at the monkeys, and what I can only describe as laughing at them! I shot one but missed the other. This was during the monsoon, and I doubted whether I should be able to save the skin, but managed to dry it on a bamboo frame-work over a fire after treating it with wood ashes—a tip worth knowing when everything is saturated with moisture. Whether wild dogs ever succeed in killing the ordinary brown monkey I cannot say, but on the Nilgiri plateau they certainly manage to secure the Nilgiri black langur, as I have on a number of occasions found their fur in wild dog droppings. No doubt they run them down when they leave the trees and make across the open, as is the habit of these monkeys when alarmed by one's own dogs.

On the Nilgiri Plateau

Most of my encounters with wild dogs have however taken place in the Nilgiris, both on the plateau and in the low country. The former is subject to both the Southwest and the Northeast monsoons, and the packs move about accordingly to escape the wet. They seem very regular in their visiting dates, and in August and September they are sure to be found on the Billithadahalla river in the Kundahs. I have repeatedly found them there at that season, and from the number of sambar carcasses lying in the water or on the banks of the river it is obvious that they make a stay of several weeks before moving on. I first met the dogs

there on 11th August 1932 while I was fishing. As I came round the corner of the 'Bamboo Pool', I saw 2 sambar hinds and a calf standing on a small rocky islet in the middle of the river, and on a small grassy maidan close by a pack of about 25 dogs. They were lying on the grass sunning themselves, 'in all their naked cui bono', to use Kipling's immortal phrase, and evinced not the least desire to chase the deer in the river when the latter bolted on seeing me. The bloody remains of a hind showed that they were full fed, and even my unexpected appearance at such close quarters seemed to cause them little concern. The nearest dog was not 25 yards away, and as 'Little Boy' rushed at him he bolted towards the rest of the pack. Some of the latter then rose, and my dog, finding he had taken on rather more than he could manage, bolted back to me, followed by 3 or 4 almost to my feet. It was the chance of a lifetime, but as luck would have it my rifle was with the shikari on the far side of the river. I withdrew out of sight, but the water was high and my shikari had some difficulty in crossing. By the time I had got the rifle the dogs had cleared off, and though I followed for some way I was unable to get a shot. Though the result was disappointing, the episode was an interesting one, as it shows that wild dogs kill only for food, whereas at times both tiger and panther will kill simply from blood lust. When they followed 'Little Boy' up to me their attitude appeared to be one of curiosity only, without any intention of hostility.

Two days later while fishing at the same spot the pack chased a young sambar stag into the water a short distance below me. I ran up but could not at first get a clear view owing to the trees and bushes lining the bank. The stag was in waist deep water only a few yards from me and I saw one dog swimming by its head—the stag was splashing and screaming, though I do not think it had actually been seized—3 dogs were yapping in the shallow water and 9 more were whimpering on the far bank. The 3 dogs started to swim across evidently intending to head off the stag. I knocked over the first as he came up the bank only 20 yards away, and then shot the second in the water, but missed the third as he ran uphill chased by my own dog. The rest of the pack bolted downstream and the stag went away in the opposite direction—it certainly was his lucky day. I hoped the dogs would return to look for their leaders, so waited for an hour while the latter were being skinned, but saw no more of them. If I had known how to call them up, I would certainly have got another chance.

As my knee was not too good, I sent my driver George with the shikari downstream in the afternoon to see if they could find the pack, and he had a very interesting story to tell on his return. When they reached the scene of the morning's encounter there were 4 sambar in the water, shortly after joined by 2 more, which first sniffed at the carcasses of the dogs which I had shot. A few minutes later 2 dogs appeared on the skyline, and George then saw that about a dozen more were sitting halfway down the slope among some rocks. They were about 500 yards away but apparently got his scent, as they came no closer but cleared off

over the hill. George guessed they would cross the river lower down by the Bison Swamp ford, and ran along the bank downstream to cut them off, but was too late, so he sat down and watched them go uphill. They soon stopped but out of range, and divided—about 8 dogs sat apart and 7 went towards a small shola. Of these 2 remained at the bottom well separated while the remaining 5 went uphill in single file along the leeward edge of the shola and beat it down. Out came 3 sambar hinds and a calf, and the dogs waiting below took up the running for a short distance only and then stopped, for no apparent reason, unless it was that the deer kept all together and would not separate.

Exactly the same thing happened in September 1935. I was returning to the de Heriez Hut from fishing when I saw a pack of dogs lying about on the grass across the river at the lower end of the 'Bungalow Reach', and managed to hit 3 of them, though only one was recovered on the spot. I sent George after the wounded dogs and when he returned with the skins he reported that he had counted no less than 22 sambar in the river and saw some dogs chasing 4 more, but as the latter kept together the dogs left them. I think the explanation must be that the dogs realise that if 2 or more deer go to bay they will be back to back and so guarding their vitals, while a frontal attack unsupported from behind will be risky on account of the very effective blows which sambar can deliver with their hooves. A single animal on the other hand can be attacked at both ends.

Mudumalai

In the low country of the Nilgiris there are two very distinct types of jungle. The Mudumalai and Benne forests which form part of the Wynaad, are subject to the full force of the South-west monsoon and consist of heavy tree jungle and tall elephant grass; while the Anaikatti-Masnigudi area at the foot of the northern slopes receives only the North-east monsoon and as a result is composed of an entirely different type—open scrub jungle. It follows that while wild dogs are resident in the Anaikatti area and have their breeding places there, they will not as a rule be found at Mudumalai and Benne except during the dry months. Another factor which affects their visits to the latter forests is the length of the grass, which when high offers a great impediment to hunting while it affords cover to the deer. It is very noticeable how seldom one meets dogs in that area when the grass is high and has remained unburnt for a number of years, and I think that an additional deterrent is the fear of cutting their pads on the sharp grass blades. Whatever the reason, the fact remains that even in the dry months their visits to that tract are intermittent and they will not be found there throughout the year.

Scouts

An interesting point which I think has not been recorded so far, is that when wild dogs decide to return to an area from which they have been absent for some time, they first send in advance

one, or at most two scouts, and it is not till these have returned and presumably made their report, that the main pack arrives. During the past 24 years I have observed this on many occasions, and do not think there can be the least doubt about it. At Mudumalai the scout nearly always comes down the Benne road from the west, and after circling round by the Doddokatte path, returns by the same route. Unless it is shot, one may be quite sure that the pack will appear on the scene within 48 hours and often less. After all there is really nothing very extraordinary about it. The intelligence of the wild dog is of a very high degree, and the way in which they combine when hunting proves that they have some method of communication. Bar-headed geese in the South similarly send out a scout in advance to examine the tank where they intend to spend the day, and unless he is satisfied that conditions are suitable, the main flock will go elsewhere. This is well-known, and I see no reason why we should credit the wild dog with less intelligence. To give one example out of many in my diaries, at 6-30 a.m. on 11th May (1948) I met a single wild dog on the Benne road not far from the Game Hut, but could get no shot though I followed it into the jungle. Next day at 2.45 p.m. while I was enjoying a siesta, a pack of 20 dogs chased a chital fawn into the Hut compound. My servant who hurriedly woke me said the whole place seemed full of dogs. By the time G. and I had got our rifles they had gone, and though we did contact them again by calling up (3 toots on an empty .318 case) we failed to bag any. Till we saw the scout there were neither droppings nor tracks of dogs to be found anywhere in the locality, but an examination of the Benne road showed that the pack had used the same route by which the scout arrived and by which he returned. Personally I don't think there can be the least doubt about the matter, but would welcome the views of other sportsmen on this subject.

The popular idea, repeated in almost every shikar book, that wild dogs clear the jungle of all game, however true it may be of other parts of India, most certainly does not apply to the Mudumalai area, where the long grass affords such excellent cover. Again and again there has been a pack hunting the locality throughout my stay of a week to 10 days, and though the chital were certainly wild and scattered, there was no question of their leaving the place. Even in the open scrub jungle at Anaikatti where conditions are so favourable for hunting, and where wild dogs are to be found practically throughout the year, there are always a certain number of chital and sambar, though black buck and four-horned antelope are admittedly nearing extinction.

Anaikatti

Many times have I taken toll of the packs at Anaikatti, and the following extract from my diary for October 1926 gives a typical encounter. I was sitting up one evening on a rocky knoll about 3 miles from the Forest Bungalow when my shikari Kala, who was watching the opposite side, ran back with news of a pack approaching along the path below. It was too far for a certain

shot but I got ready, and shortly after saw the dogs beneath us—they looked very red and snaky seen from above, and the black tips of their brushes showed up very clearly. I whistled to them but they paid no attention, so called and they halted. Aiming clear below the nearest dog's body (they were 100 feet below me and looked like rats) I fired, and had the satisfaction of seeing him go over. He then got up and began whirling round and round. Kala said he then fell over into a bush, but I did not see this as I had dashed up to the top of the rocks for another shot. However they did not stand, so we hurriedly descended and ran some 400 yards after them. Suddenly we came upon them round a corner and the bushes literally spouted dogs all round us—one was half crouching with head down and ears laid back under a bush 40 yards off. I thought it was the wounded one so fired and knocked him over—another took his place and I then saw that it was eating something—we found afterwards that they had just killed a hare. I fired but was unsteady with the run and missed. It dashed away close past me and I had a snap at 10 yards, but the cartridge had not come up from the magazine so nothing happened. Hurriedly reloading I ran round the bush and saw the dog loping away 40 yards off. A lucky shot in the middle of the back rolled it over stone dead, and that was the only one we actually collected, as the other two got away into thick stuff and could not be found. Wild dogs are extraordinarily tough animals and will get away with the most frightful wounds.

Vultures often give away a pack by circling forward over it without descending, and if you see a dozen or so doing this it is worth while investigating, as I have found on more than one occasion. But generally speaking it is pure luck whether one comes across them or not, even though a pack may be hunting the area for a week and one is after them every day.

If a dog has been shot, it pays to get under cover and try to call up the remainder by 3 toots repeated at half minute intervals, on an empty rifle case. The chances are that one or more will return to look for their wounded comrade. This method may also be used when no shot has been fired, but in that case a better plan is to blow on the edge of a leaf held vertically between the thumbs—the resultant squeal will almost certainly induce some dogs to investigate. An aniseed trail is said to give good results, especially during the breeding season (October-November), but I have had no success with it.

Breeding Season and Localities

I once shot a bitch containing 9 embryos 'all beautifully formed with claws complete and presumably about one month gone', according to my diary. That was on 3rd November and confirms my experience that most, if not all, pups are born in the latter half of November or during December. It is the exception to find them after Christmas.

The country round Anaikatti and Masnigudi abounds in rocky caves sufficiently large to admit a dog or even a boy, but too small for a man to enter, and it is here that the wild dog nurseries are

located. Generally there are several earths close together, but at times the pups of more than one litter will be found in a single earth. Such was the experience of my friend B. many years ago when he took no less than 12 pups from under a large rock, and of S. who took 11 under similar circumstances. But personally I have never found more than 7 pups in one cave, and generally from 2 to 5. Access to the caves is often difficult even for a small boy, and generally involves a certain amount of digging, especially in loose earth where the tunnel may be some yards long.

Whether there is a single earth or more, a guard-bitch will always be on watch outside from dawn to dusk. She takes no part in the feeding arrangements, which, as is well known, is effected by the pack returning from a kill either carrying meat in their mouths or vomitting it up. Her job is simply that of watch dog, and the moment she gets a whiff of human scent she will clear off and will not return so long as the intruder is there. Moreover, she will also intercept the returning pack and prevent them from approaching the cave. It is therefore very desirable to stalk and shoot the guard-bitch before any attempt is made to dig out the pups. Shikaris tell one that both she and the pack are liable to attack any man found in the vicinity of the nursery, and B. told me that when he neared the cave from which he subsequently took the 12 pups, the men would not let him approach till 4 wild dogs which were vomitting up meat had left, and until the guard-bitch had been shot. That the 4 dogs would have attacked I find it hard to believe, but the trackers must have had some reason for their apprehension, since normally they show not the slightest fear of a pack however large. That the bitch on guard would attack is, I am quite sure, a mistaken idea. My own experience is that she clears off on the slightest suspicion. On one occasion, when the guard-bitch got away unfired at and it proved impossible to extract the pups from the cave, we fixed a wire noose over the mouth of the latter, hoping to catch her when she returned. This plan succeeded, but unfortunately she managed to break loose before we returned at dawn.

At times instead of caves, holes are dug in the flat ground, and it was a warren of this type which I first came across near Sigur at the foot of the northern slopes of the Nilgiris in December 1925. There were 6 or 8 earths dug in a small flat maidan, but though they were quite fresh and the season rather far advanced, they were untenanted. The whole of that area is now covered by a regular sea of lantana, so I have not been able to revisit the spot.

Except for his handsome appearance, the wild dog has not a single redeeming feature, and no effort, fair or foul, should be spared to destroy these pests of the jungle.

Burmese Wild Dog

Is there a separate grey species of wild dog in Burma?

In his article on the Indian Wild Dog, Col. Burton states that no material is yet available to establish the identity of the

wild dogs of Burma, and this remark encourages me to relate the single instance of my meeting one there. That was on the 21st April 1913, while I was in camp at Thaygon near Paungde, on the line between Rangoon and Prome, and all that my diary records is: 'This morning saw a wild dog quite close but could get no shot. Its colour was grey. Pollock states there are none in Lower Burma, but villagers say it is quite common here'. I cannot now recall the incident, and can only regret that I failed to bag the animal, whatever it was. I was always very careful in writing up my diary, and certainly should not have described it as a wild dog unless I had every reason to believe this to be the case. I could hardly have mistaken a jackal, besides I do not remember ever meeting the latter in Burma. So it remains rather a mystery.

In this connection, 'Big Bore' writes in *A Guide to Shikar in the Nilgiris*: 'A peculiar variety of wild dogs exists in the Karen Hills of Burma thus described from a specimen in confinement. It was black and white, and as hairy as a Skye terrier and as large as a medium spaniel. It had an invariable habit of digging holes in the ground into which it crawled backwards, remaining there all day with only its nose and ferrety eyes visible.' What authority the late Mr. Shehan had for this statement I do not know, but he was a very competent naturalist, and I feel sure would not have included the above description in his book unless he had believed it to be correct. It is therefore possible that a grey species of wild dog exists in Burma and still remains to be authenticated. Members of the Society who have resided long in that country may perhaps be able to throw some light on the subject. During my $6\frac{1}{2}$ years there I never met another wild dog either red or grey.

WOLVES

My jungle memories of wolves are limited to two encounters near Poona about 1908. I was out at the time at Lonikhand, which in those days was an excellent centre for black buck and chinkara, and while I was stalking an unusually fine buck, I became aware of 5 wolves sitting on a ridge about 200 yards away evidently interested in my proceedings. I was in half a mind whether to leave the buck and go after them, but could see no covered line of approach, so maintained my original objective; and that was the last I saw of them. Not long after I came across a pair in the same vicinity and had a long running shot which missed. As my horse and spear were handy, I then tried to ride them down, but they got into such broken ground that I had to abandon the chase.

In 1930 while living in Mysore City I was informed that wolves had been shot not far away some years before, so spent some time combing that and other likely areas. But I could neither find one, nor even get any recent information of their existence, and finally came to the conclusion that they had died out. Again while on tour in the Ceded Districts during the recent war, I was told that a couple inhabited a cave in a small rocky hill not far from Anantapur; and at Penukonda I was assured that some took toll of the flocks of sheep every year during the monsoon, but I was

never able to find time to investigate further. If any do still exist in Southern India, the Anantapur District seems the most probable locality.

So I have never bagged a wolf, and my memories of this animal are confined to the two incidents near Poona, as narrated above, over 40 years ago.

HYENAS

The hyena's laugh is proverbial, but how seldom is it heard! During 45 years in India I can record only a single instance. In December 1918 I was stationed at Karachi, and as soon as possible after the Armistice, got 10 days leave and marched North-west with camel transport across the border into unadministered territory. Several days' trek brought me to the far side of a range of rugged hills which I had visited as a subaltern in 1905, and which I was told still held 'gud' (as oorial are termed locally) and Sind ibex. While in camp there I was woken one morning some hours before dawn by a most infernal uproar. It was a hyena, no doubt attracted by the meat of a gud which I had shot on the previous evening, and which was hanging by the kitchen tent. My diary of that trip is unfortunately little more than a record of distances marched and of animals shot, so I cannot quote from it verbatim, but I shall never forget the unearthly staccato yells, shrieks and howls which the animal made. I did not realise what it was till I looked out, when it bolted without giving the opportunity of a shot. And that is the only occasion on which I have heard a hyena make any sort of noise.

One I remember shooting by mistake many years ago in the Raipur jungles. At the time we were following a wounded bear which had entered a cave, and while peering down between the huge rocks which formed it, I saw something move in the shadows below and fired at it, thinking it was the bear. But when we went down and pulled it out, I was disgusted to find that all I had bagged was a hyena, and that too a very mangy specimen compared with those I have so often met in later years in the Anaikatti jungles at the foot of the Nilgiris.

The only one at which I have deliberately fired was near Gundlupet in Mysore as long ago as 1926, and my reason for doing so was that I wanted a stuffed head for my collection. I was looking for black buck near the Sugarloaf Hill soon after dawn on 23rd July, when I noticed a hyena slinking away across a low crop of millet. I ran round to cut him off, and knelt down behind the slight thorn hedge on the far side, while my two men and 'Little Boy' beat across the field towards me. The hyena cantered out only five yards away and looked distinctly nasty when he saw that he was intercepted. Only the low hedge separated us, and I must confess that for a moment I wondered whether the cowardly behaviour attributed to these animals was altogether correct; but before he could recover from his surprise, a bullet in the neck from my No. 2 Express dropped him. He proved to be a fine specimen in excellent condition, and the head when set up made quite a good trophy.

Since then I have repeatedly come across them at dusk round Anaikatti, where they are common, and more than once have for a few startled seconds thought I had met 'Tom Puss' himself; in fading light there is a marked resemblance. On a number of occasions also I have had them pass quite close during small-game beats, but I see no use in shooting them as the trophy is a poor one, and on the other hand they are extremely useful scavengers. They are often described as 'vermin', but why they should be so classed I cannot imagine, for true vermin whether furred or feathered is destructive to other game, and this the hyena most certainly is not except perhaps for a very occasional chital fawn.

Though they are common round Anaikatti, I have never come across one in the Mudumalai forest where the long grass and heavy tree jungle are little suited to their liking. On the Nilgiris plateau they are rare. Over 20 years ago an old hyena used to leave his tracks and droppings every night on the bridle-path from Hodgson's Hut to Andy Corner, but there has been no trace of him for a long time. Their habit of making regular nightly rounds is a marked feature; one has for many years visited the Anaikatti village every night, coming by the game-path from the vicinity of Temple Hill and returning by the same route.

Do wild dogs eat hyenas? I should imagine that they seldom get the chance, as the former hunt principally by day, and the latter seldom leave their caves before nightfall. But I was informed by that well-known sportsman, the late Mark Clementson, in September 1933, that a few days previously he had shot a hyena and left it out overnight. When he returned next morning he found a pack of wild dogs eating the carcass, and bagged two of them.

The behaviour of hyenas *vis-a-vis* panthers has already been described in the section dealing with the latter animal, so I will not repeat it here. Taking them by and large they are uninteresting brutes, and my best memory is of the practically face to face encounter across the low thorn hedge near Gundlupet.

JACKALS

There is only one point of real interest to the shikari in connection with these animals, and that is their well-known 'pheeal' cry. It was at one time supposed that this was made only when a jackal sighted a tiger or panther, but I think it is now generally admitted that it is merely a signal of alarm at something suspicious. An experience of my own tends to confirm this view. On 25th August 1935 I was marching out to the de Heriez hut in the Kundahs, and as it was raining hard I and my three men were all wearing waterproofs. Half-way between the top of the Avalanche pass and the junction of the Billithadahalla river, I noticed three jackals some distance ahead on the open sloping hill-side on our right. As we approached two of them bolted, but the third stood his ground and started the 'pheeal' cry, keeping it up till after we had passed, not 40 yards away. No doubt he could not in the rain make out exactly what we were and accordingly gave the alarm. He could hardly have mistaken us for tigers

at such close quarters, even though we were all wearing long khaki waterproofs. Had the pack ponies been with us, he would no doubt have recognised us as humans and bolted at once, as his companions did, but we were a mile or more ahead of them.

Do jackals ever mate with domestic dogs? I remember seeing a mixed couple in a cage in the Mysore Zoo many years ago, but whether anything came of it I do not know. I rather think there was a record of it in the *Journal* at the time. The single instance of possible mixed mating which has come to my notice was while I was on tour during the war. I had left Cannanore some hours before dawn, and as we reached the Anjerakandi cross-road about ten miles out, the headlights disclosed a small white bitch playing with a jackal. They certainly appeared to be on extremely intimate terms and I imagine that but for our approach mating would undoubtedly have taken place.

In the plains of India, at any rate in the South, the jackal carries such a poor coat that it is not worth shooting, but in colder climates the fur is long and thick, and makes up into a handsome car rug or jacket. I have one of the latter made out of the skins of three which I shot near my post at Khan Nuktah between Baghdad and Faluja in the winter of 1917, the only ones that I can remember to have fired at. On the Nilgiris plateau during the cold weather jacks carry very fine coats indeed, but their pursuit is, very rightly, restricted to the Ooty Hunt, and they are not allowed to be shot.

Apart from his 'pheeal' cry, the jackal is almost as uninteresting as the hyena, and hardly deserves inclusion in this series.

(*To be continued*)

A SOUTH INDIAN PELICANRY.

BY

K. K. NEELAKANTAN, B.A. (HONS.)

(With a map and a plate)

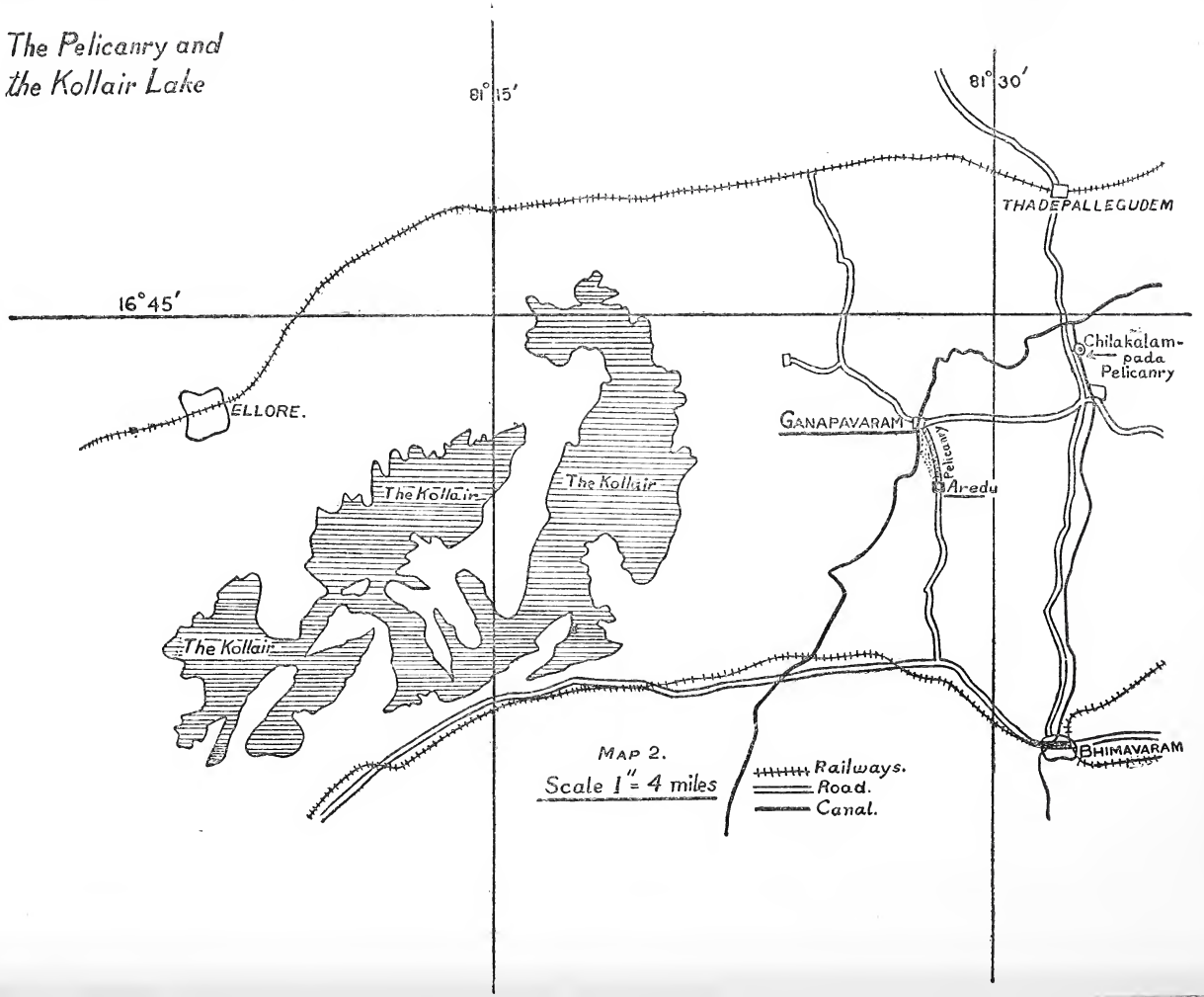
Even during the infancy of Indian ornithology a number of pelicanries like the famous one at Kundakolam (Nunguneri taluk, South Tinnevelly) were discovered here and there by pioneers in the field. But very little detailed information has been published about these, and our knowledge of pelican life in India is very meagre.* My curiosity and interest were therefore aroused when I heard of a village in the West Godavari District where every year 'large duck-like birds bred in thousands', and guessed that it could only be a pelicanry.

Thirteen miles from the Thadepallegudem station on the M. & S.M. railway route from Madras to Calcutta, there is a large village called Ganapavaram with a hamlet by name Sarepalle at its southern end. Two miles south of Sarepalle lies another village called Aredu (see map). The land between these villages is a vast level stretch of paddyfields with long rows of palmyras planted along the bunds. In certain places, as on the banks of canals and some raised broad bunds, stand clumps of rain trees, mango, tamarind, jambul, neem and babool trees. Among these the rain trees are the most common.

The Tadepallegudem-Bhimavaram road runs north to south across this cultivated plain, and midway between Sarepalle and Aredu a small irrigation canal, running east to west, cuts across the road. In this area paddy is grown only once a year as a rule, but every three years water for a second crop is also made available. Thus in 1947 and 1949 the fields were all dry, sun-baked and stubble-covered after December, whereas in 1948 they were green with growing paddy standing in a few inches of water even in April.

The pelicanry itself extends from the outskirts of Sarepalle to Aredu covering a distance of about two miles and spreading on either side of the road for about two furlongs. All parts of this area are not used by the birds at the same time. Besides, a spot which is thickly populated in one season may have only a few nests in the next; and a place totally unoccupied one year may be swarming with birds the next. Though Aredu is said to have been the original breeding centre of the birds, and was actually found thickly inhabited by them in April 1948, there was not a bird or nest to be seen south of the Madhyakaluva in 1949 (see map). In 1947 a clump of trees close to Sarepalle was almost overcrowded; in 1948 the numbers were smaller, and in 1949 there were only a few nests here and there. But the rain

* For the latest report on Kundakolam, where now only 10 pairs of pelicans breed, see *J.B.N.H.S.* 'Notes on a few birds from the South of the Tinnevelly District by C. G. Webb-Peploe, Vol. 45, No. 3.


The Pelicanry and
the Kollair Lake
81° 15'
81° 30'
16° 45'
THADEPALLEGUDEM
ELLORE.
Chilakalam-
pada
Pelicanry
GANAPAVARAM
Pelicanry
Aredu
The Kollair
The Kollair
The Kollair
BHIMAVARAM
MAP 2.
Scale 1" = 4 miles
Railways.
Road.
Canal.

trees and coconut trees north of the Madhyakaluva were found used every year.

There is little difference in the nature of the land between this and the contiguous areas, but the birds do not go far from the road. In Aredu the birds used to nest on trees within the village itself. Some nests were on a small thorny tree less than a couple of yards away from the busy bus route. This preference for trees near the road is most probably due to the fact that chances of protection are greatest where villagers are always within sight. Pond Herons breeding in my village in Malabar show the same instinct, and nest only on trees standing within enclosures.

According to the villagers this sanctuary has been in existence from time out of mind. Many years ago the birds used to nest only in and around the village of Aredu, but owing to some shooting they moved north towards Sarepalle. For a time they avoided Aredu but returned again and were left unmolested till 1949, though their activities destroyed a good many of the trees in the village. This year, however, some trees were cut down and the villagers are said to have prevented the birds from occupying the remaining ones.

There has never been any official guarding of the pelicanry; yet some sort of understanding exists that no one should harm the birds or take eggs or young ones. The local Muslims alone seem to fancy the flesh of pelicans; a few birds are said to be shot occasionally by them on their way to and from the pelicanry, but this has not had any noticeable effect on the others. As the birds usually fly high when away from the pelicanry, there is little chance of their being shot at too often.

The pelicans arrive without fail during Dasara (end of September or first week of October) and begin nesting activities forthwith. Some villagers said that if there was rain soon after their arrival, the birds disappeared for a short while and returned only after the showers. They remain till about July, but from April onwards the numbers begin to diminish. One old man pointing to a large group of adult birds assembled in a field in March (1949) said that it was a 'meeting' held to fix an auspicious day for departure. On an earlier trip another venerable figure had solemnly asserted that the birds invariably arrived on an auspicious day.

In all the Indian pelicanries reported hitherto, the pelicans were found breeding in company with other birds. In the Buchupalle and Kundakolam colonies pelicans and painted storks bred together, and the one at Shwaygeen (Burma) visited by Oates was 'a combined pelican and Adjutant colony'. That described here, and which may be called the Aredu-Sarepalle Pelicanry, is tenanted only by pelicans all of which belong to the spotted-billed species (*Pelecanus philippensis* Gmel). As excellent general descriptions can be found in any good bird book none is given here. Identification of this species is easy because the spots on both sides of the median bar of the upper mandible, from which the bird derives its name, are very conspicuous.

Soon after arrival at the pelicanry the birds commence nesting activities. Twigs from trees are wrenched off; dry stems of

dhal and other plants are uprooted or broken off; reeds from the tanks and canals are fished up; and even thorny babool twigs are collected and taken one by one to the nest. Some of the twigs thus carried are so short as to make the sight of the huge birds carefully carrying them somewhat ludicrous.

After a thick foundation of these twigs has been made, straw from the numerous stacks close by or from the newly harvested fields is collected and added to the nest. Though the birds have such large bills the quantity of straw carried is surprisingly small. Only some five or six strands at the most are taken at a time and carried in the tip of the bill. In many cases the straw used covers all the twigs so that the finished nest appears to be made entirely of straw. The harvesting season falls during November and December, and the birds finding straw in plenty, make a liberal use of it. Some of the birds nesting near the canal substitute sodden, decaying weeds and reed-stems for this straw.

Though the finished nests are massive structures one never finds any bird feverishly busy collecting material. The birds always go about in a leisurely way often spending five or six minutes tugging and pulling before flying to the nest with a twig some six inches long. Pelicans are certainly the most clumsy and placid of birds!

When a bird takes material to its nest, its mate (one of the birds always remains on or near the nest until the chicks are some weeks old) puts up and opens its bill, stretches its head, gives vent to a number of groans, and finally, receiving the twig or straw adds it to the nest. This neck-stretching and groaning are indulged in whenever a bird comes and alights near another, whether it is its mate or not, and seems to be intended at least partly to prevent the newcomer from alighting on the sitting birds.

Many attempts are made by these lazy birds to pilfer material from others' nests or even to receive with the most casual air, what the working partner at a neighbouring nest has brought to its mate. These attempts are, of course, resented but the birds never come to blows. A few clumsy, half-hearted thrusts of the bill are all that express the protest of the victim. Now and then, regardless of these shows of resentment, material is snatched away even from under the sitting bird.

When completed, the nests are about two to two and a half feet across, roughly circular and a foot or more in thickness. They are placed on almost every kind of tree though some varieties seem to be more favoured than others. Rain trees are the most popular and it is on these that the largest groups of adults and nests are found. Next come coconut and palmyra trees. Mango and coconut trees are few in number, but almost every one of them is used by the birds.

On the branching trees the nests are placed on strong forks or at places where a number of branches stand close together offering a firm foundation. Those on the coconut trees are placed at the bases of the lower fronds which are more or less horizontal. On palmyra trees the nests are usually built at the base of the lowest leaves, but a few are placed higher up on the leaves themselves.

On palmyra and coconut trees very often nests are placed all around the stem in a continuous ring so that one cannot easily say where one nest ends and another begins. On many-branched trees also two, three and even four nests may be built so close together as to form one large platform.

Till about the end of February the nests are continually added to or repaired with twigs and straw. From March onwards very little work is done on the nests. In most cases the chicks become so big by this time that their movements completely destroy the nests and they are forced to perch on the branches of the nest-trees or of those close by. After the middle of March only a few nests are found; these invariably contain small chicks. Meanwhile the ground under the nesting trees becomes cluttered up with the debris of these nests. Some get so cemented together with the droppings of the birds that they can be lifted up by a single twig. When the nest is finished three to four chalky-white eggs are laid. There seems to be the usual number though it is not in every case that all eggs hatch out successfully.

When a few days old the chicks are covered all over by snow-white down. The first touch of colour appears when the grey feathers of the tail begin sprouting. Then the wing feathers grow gradually and become darker as they grow. The grey 'mane' on the nape and the crest are also formed meanwhile, adding another touch of colour. The bill becomes longer and flatter. Even the small nestlings have the pouch though this is inconspicuous and the bill looks like that of ordinary stork chicks.

By the middle of April most of the chicks attain full growth. The white of their plumage is always of an attractive pure colour and the feathers of the wing are darker and sleeker than those of the adult. From the time the egg is laid it takes about five months for the chick to become full grown; towards the beginning of the fifth month it begins to fly.

The chicks are lethargic and, as a rule, not very noisy. They lie quietly in the nests or perch close by silently until adults arrive with food. Then the nest becomes lively; the chicks stand up and start swaying about and flapping their wings to the accompaniment of all sorts of throaty noises. Again when the parent leaves, they settle down and remain very quiet.

The parents are for ever on the move after eight or eight-thirty in the morning, going out to get food or coming in to feed the chicks. They go about usually in flocks of varying size, the average number of birds in a flock being fifty or sixty. Because of this habit of flying in flocks, the feeding of chicks takes place at roughly the same time in entire sections of the pelicanry. Moreover the feeding takes place at fairly regular intervals, the frequency of it being in direct proportion to the size of the chicks.

The arrival of the adults puts the chicks and the Brahminy kites on the alert and the movements and noises suddenly increase. While the flock as a whole wheels about above the trees, one by one the birds descend to their nest-trees and prepare to feed their chicks.

A parent alights on a branch near the nest and coughs up, or regurgitates, what it has already fed on. Meanwhile the chicks

scramble towards it clumsily, lurching about like drunks, grunting, groaning and yelping. On nearing the parent they grunt with renewed vigour and start waving their necks and wings awkwardly, making frequent attempts to catch the parent's bill. In course of this the chicks repeatedly open and close their bills producing a number of resounding claps. At last one of the chicks takes hold of the parent's bill; the latter opens its mouth wide and the chick thrusts its whole head into the pouch. Often enough the young one's bill goes deep into the parent's gullet and gets stuck there.

This wonderful performance, though harmless, is quite as thrilling as a sword-swallower's act for some of the bigger chicks have bills quite a foot in length and thrust all of it into the parent's throat. For a time after the chick has dived in there is little movement other than a few half-hearted flaps of the wing and slow swaying of the necks. When the parent feels that the chick has had enough, it starts swinging its head until the chick lets go. A few moments later the same or some other chick repeats the performance; and this goes on until the adult hops off or flies away. Quite often after one chick has just fed, another goes up to it, forces its bill open and tries, often with success, to get a share of the food. Another peculiarity noted was that now and again two chicks managed to thrust their bills into the parent's mouth and to feed simultaneously. When a chick has been fed it sometimes moves off, coughs and disgorges a few pieces of food which either fall on the nest or to the ground. When the pieces fall on the nest, the parent picks them up and swallows them again. Scraps fall off invariably whenever feeding takes place.

In November 1948 before the eggs were hatched I came across the head of a big fish under one of the nest-trees. It is probable that this was the remnant of a fish brought to feed a brooding bird though I never caught any adult in the act of feeding another.

The Rev. Howard Campbell found the pelicans of Buchupalle 'bringing quantities of a fine trailing of waterweed from a tank about two miles off, to feed their young' (Baker & Inglis; Birds of Southern India, p. 424). Though the Kolleru water is full of all kinds of water-weeds the pelicans of the Aredu-Sarepalle pelicanry never seemed to bring any of it for feeding their young. All the food was regurgitated, never carried in the bill or pouch, and seemed to consist entirely of fish.

One of the first questions to strike the observer is, 'Where in this dry place do the birds procure all this food?' The 'sanctuary' is a vast stretch of dry land where water for cultivation has to be brought through irrigation canals. These canals are mostly shallow and narrow. The one big canal which passes through the pelicanry is only some ten to fifteen feet across and five or six feet deep. Most of the time the birds are here this canal, in the dry years, is only five or six feet broad and two or three feet deep. There is a small tank near the road in the pelicanry itself and three larger ones in the Sarepalle-Ganapavaram area. There is a major irrigation canal which skirts the western bounds of the pelicanry and some other small canals and tanks are also

Rain trees and palmyras on canal bund.

Photos by *Author*

Fallen chicks resting under trees, waiting for feeding to begin on nests above them. (Note thick white deposit of droppings on bund under the tree).

found round about the place but even if all these are put together the amount of food they can provide for the birds must be very small. Moreover rarely are the birds found resorting to these canals or tanks except when in search of nest-material. The villagers assure us that the birds go to the Kolleru (Kollair or Colair lake)—a very extensive but shallow lake which contains plenty of water till April and quite a considerable quantity even during the drier months. There is every reason for believing the villagers right in this matter. The lake is only seven miles away from the sanctuary and lies roughly to the west (see map). The adult birds from the pelicanry always drift off to the distant northwest and return from that point. It may be safely assumed that they go to the Kollair for food as even the 1" map does not show any body of water west or north of the pelicanry other than this lake. On the 5th of April 1948 when I was on the Kollair I saw a flock of thirty or forty pelicans soaring overhead, and Mr. Thirunaranan, Lecturer in Geography, Government Training College, Rajahmundry, remembers to have seen a few pelicans on every one of his numerous trips to the Kollair. I believe that these must have come from the Aredu-Sarepalle pelicanry.*

Pelicans are usually called 'Thithigōdalu' in Telugu, but in Ganapavaram and Aredu they are known as 'Kolletigōdalu' which means 'gōdalu' of the Kolleru.

Though the pelicans of this place seem to have no enemies whatsoever there is a considerable amount of egg and infant mortality. Owing perhaps to the clumsiness of the birds and their occasional bickerings, some nests fall off the trees. Eggs that drop off are eaten up ravenously by the crows which haunt the 'sanctuary' in hordes during the first few months of the breeding season. Chicks that fall down are completely ignored thereafter by the parents and have to fend for themselves. After a certain period, that is when the chicks are able to flap about a little, they cling on somehow and avoid such a fate.

Very small nestlings that fall off die before long, but those that are half-grown put up a good fight for survival. Some make desperate but vain attempts to climb back to the nests where these are on spreading trees. Some manage to reach a shallow pool under some of the rain-trees which are heavily covered by nests and birds. Once there, they plough up the mud at the bottom, like ducks, in search of food. But more often they become scavengers and, flocking under those nests where feeding is going on, snatch up the pieces of food that are dropped. All those that live more than a day become very grimy and diseased-looking. A few manage to live on for a surprisingly long time, but I have not been able to ascertain whether any of these ever survive the

* In March 1949 a small colony of nesting pelicans was discovered at Chilakalampada, about six miles north-east of Ganapavaram (see map). I could not stop at the place on that occasion and had to leave Rajahmundry shortly after. As no villager even in Ganapavaram knew of its existence I think it is a new one where, perhaps, birds driven away from the neighbourhood of Aredu settled down. This however is only a bold guess. It may be noted that this small colony of about fifty nests is farther away from the Kollair than the Aredu-Sarepalle one by five to six miles.

season and manage to fly away. It would not be surprising if a few of the bigger ones grew to adult size and led normal lives thereafter.

These unfortunate creatures seem to know well that they cannot make the adults recognise or help them. When two or three are together they are very friendly and occasionally preen and even feed one another as the chicks in the nests do.

Death is always the result of shock from the fall, or of starvation. Even the smallest of the chicks is able to defend itself and the strong blows it gives with its hook-tipped bill keep off all aggressors including man. Though crows go about in flocks looking for dead chicks, and jackals live in the pelicanry itself, these never seem to attack live chicks. When the chicks die they are quickly eaten up by the crows and jackals. Still every now and then one comes across a perfectly preserved body, with not even a scratch on it, rotting away. Why a few are left untouched like this is a mystery. Vultures never seem to feed on the dead chicks though White-backed Vultures in large flocks often soar over the pelicanry and even roost on a few of the palmyra trees.

The fallen chicks which try to exist on the fragments of food dropped from the nests have to put up with a lot of competition because the sanctuary attracts and harbours a good many Brahminy kites, adult and juvenile, which exist mainly on these scraps. They perch on the nest trees or on those close by and the moment feeding begins at a nest, dash this way and that under the trees, screaming. In a matter of seconds even the tiniest fragment is picked up and swallowed and one cannot get even a microscopic sample of the food!

The number of Brahminy kites found here is certainly unusual. I have seen this kind of crowding only where largescale fishing is carried on by fishermen. Pariah kites are very common in the villages on either side of the pelicanry but are rarely found in the sanctuary itself.

Writing about the Shwaygeen pelicanry which Oates visited in 1877, B. E. Smythies says in his 'Birds of Burma': 'The most striking point about this pelicanry was the complete silence that prevailed save for the whistle of the wings of birds flying far overhead'. In the Aredu-Sarepalle pelicanry no such eerie silence reigns. The pelicans make a good deal of noise with the Brahminy kites contributing their mite which is by no means inconsiderable.

The noises made by the pelicans are not very loud, however, and, at a distance of a couple of furlongs, are hardly audible. The sound most often heard is a peculiar long-drawn throaty grunting reminiscent of the grunts of buffaloes and the funny noises produced by the oil mills of South Indian villages. Always there are various other sounds mixed up with these. A *yap-yap* sound like the yelping of a pup is quite a common one. Some of the sounds uttered by the chicks are almost human. When wanting to be fed they give vent to heart-rending groans punctuated by sounds like *Ayya, Ayya, Aay-yā-yā*, and so on. To add to all this both adults and young ones again and again open and close their bills producing sounds like that of loud clapping.

It need not be said that where such large water-birds as the pelicans breed in numbers their droppings do incalculable good to the soil. In this pelicanry the quantity of faecal matter is never very obvious to the eye though most of the trees and the ground beneath become so completely covered by it that from a distance they seem to have been carelessly whitewashed. Where a thick deposit of this matter is formed all minor vegetation is smothered and dies out completely as it does in a place where ducks have been penned for a number of nights. The villagers are well aware of the value of this natural fertiliser, but do not as a rule collect and use it. They feel that as it gets absorbed by the earth or dissolved in the water the crops are benefited even if no systematic distribution is carried out by human agency. There is no doubt whatever that the fields in this area derive immense benefit from this manure.

Unfortunately, there is another side to this picture, which is equally obvious. The birds cause considerable damage to the trees which they use. The branching trees lose most of their leaves soon after the birds occupy them. Coconut trees droop, and in the course of years dry up and die. Even the sturdy palmyra leaves bend down under the weight of the birds and become diseased-looking though they do not seem to suffer permanent injury.*

Whether it is the weight and the clumsy movement of the birds or the thick white coating of faecal matter that completely covers up every tree that causes this destruction is not easy to say. Coconut trees are probably affected by the first of these causes. In the case of trees like the mango, when the leaves take on such a thick coating of this cement-like matter they just wither away and the trees neither grow nor bear fruit. Even were the trees to put forth blossoms the activities of the birds would soon cause all of them to drop off. As coconut and mango trees are prized possessions of the local farmers, their tolerant treatment of these destructive birds certainly proves their goodness of heart and respect for tradition.

Though various attempts were made to count the number of nests and adult birds they did not prove successful. In April 1948, Mr. Thirunaranan and I roughly estimated the number of nests (counting every compact group of four or less than four chicks as a nest) at 150. Basing other figures on this, we put down the number of adults at 300 (not counting non-breeding birds) and the number of chicks at 450. I feel, however, that this is too guarded and conservative an estimate to be of any value. This year, (March 1949) I attempted a rough count and decided that there were more than 400 nests and so perhaps more than 800 adults and 1,200 chicks. Though these figures are very approximate they are given for what they are worth. The counting of nests is in itself a job for a team of interested observers which should include at least one expert climber. The counting

* My attention was recently drawn to a short note on a similar subject contributed by Mr. McCann to the *J.B.N.H.S.* (Vol. 42. No. 2). He describes therein the damage done to the brab and coconut palms by roosting vultures.

of the adults seems almost impossible as many of them are always on the move.

From this superficial account it must have become clear to the reader that a great deal of work has to be done to enable us to form a full picture of the life and habits of these birds. Apart from such things as the recording of the day to day changes right through the season, the careful counting of the nests, adults and chicks, the timing of the movements of adult flocks, a study of the courtship, of the behaviour, movements and proportion of non-breeding birds, of the food, its exact sources and the method of procurement, there is the most interesting question of where the birds go during the fall season. (Sálim Ali in the latest edition of 'The Book of Indian Birds' writes, 'Migrant. But movements imperfectly known'). This can only be settled satisfactorily by large scale ringing of the chicks at least. This too is a task for more than one man and the expenses involved are heavy enough to put it outside the reach of a mere amateur.

One of the many interesting problems presented by the pelicanry is that of learning the relationship between the moulting of the adult's plumage and the age of the chicks. Right through the breeding season the adults undergo obvious changes in their general appearance. At the commencement of the breeding season they are mostly dull whitish with the crest and the 'mane' of the neck grey, tail and flight feathers blackish. By February most of the birds become brownish from the breast downwards. This colour which becomes gradually deeper looks like some stain. The wing coverts become more and more whitish and ragged; the crest and mane become darker. By the middle of March the whitish colour of the wing coverts disappears and a sleek, dark greyish brown replaces it. The underparts in most cases lose the brown colour and become dull white or pale greyish. I could not find out the exact relationship between the stages of the moult and the age of the chicks, but there is no doubt that the two are related. In March 1949 only birds which had small chicks in the nest were still whitish and ragged above. Those which had well grown chicks were very neat and well-groomed. Towards the end of April it is difficult to distinguish between adults and full grown chicks. Till then the length and colour of the bills (whitish or pink in chicks and bluish in adults) and the colour of the underparts (snow-white in chicks, grey or brownish in adults) enable them to be told apart easily.

It may also be mentioned here that the adults moult their wing and tail feathers during the breeding season as is proved by the absence of some of these in most birds at certain periods. Hugh Whistler in his 'Study of Indian Brids' (published in this journal some years ago) wondered whether anything like the peculiar horny combs that adorn the bills of the White Pelicans of America during the breeding season are found on Indian pelicans also. The Spotted-billed Pelican has not been found to develop any such ornament and there is no difference between the bills of breeding and non-breeding birds.

The future of this pelicanry seems at present uncertain. The Kollair Lake is the main source of food for this large body of birds. According to the schemes of the Government of Madras when the Ramapada Sagar project on the Godavari is completed the Kollair will be partly drained and brought under cultivation. Even if a small lake is left in the deepest part it may be so small in extent and its water content so low as to make it impossible for the pelicans to exist on the fish provided by it.

In an article in 'The National Geographic Magazine' (January 1949) on the Everglades National Park, the author points out that conservationists have successfully resisted all attempts at drainage of that marshy area because, if water is drained off the food for breeding birds will fall so much below their need as to wipe the sanctuary out of existence. Could our Indian naturalists put up an equally good fight and prevent such a short-sighted procedure as the draining of the Kollair?

It is not merely a question of the survival of the sanctuary that is involved here. The Kollair is the only lake of its kind in the south on the east coast and it attracts and harbours a very large number of birds of various species. With the draining of the Kollair an important haunt of some of our ducks (to mention only the most outstanding and perhaps the most numerous of the birds of Kollair) will disappear thus decimating the bird population of this unique ornithologists' paradise.

These days institutions all over the west have realised the danger faced by wild ducks and taken measures to prevent the numbers from falling below the present level at least. If we in India allow the few major duck-haunts like the Kollair to be drained and those like the Chilka lake to be shot over at will by indiscriminate sportsmen, soon a number of interesting species will have to be written off. Places like this should be declared sanctuaries and maintained zealously as such, so that we can not only prevent some birds from going the way of the Passenger Pigeon and the Great Auk but also create centres for bird study and bird-banding.

Even if the Kollair were left undrained the future of the pelicanry would still be uncertain. The villagers have become conscious of the harm done by the birds and their hostility has already caused the birds to desert Aredu. If the pelicans are thus driven from place to place, they may finally desert the pelicanry altogether.

The dates of visits paid to this sanctuary, and a few observations are given below :

(1) 15th April 1947.—Land dry and fallow. Almost all chicks well-grown. Many flying. No nest seen.

(2) 4th April 1948.—Water in fields—growing paddy. Birds occasionally alighted in water-logged fields but still drifted northwest for food. 1 nest contained small chicks. Other chicks all well grown. Whole area including Aredu well populated.

(3) 11th September 1948.—Growing paddy in fields. No pelicans.

(4) 27th November 1948.—Fields mostly harvested. Haystacks everywhere. Pelicans had almost completed nest-building. Nests not conspicuous. Birds sitting on eggs. Broken shells showed eggs were fresh. Birds were busy collecting nest material. Near one nest three or four adults were seen, some of them obviously non-breeding birds. (Why do they stand around the nest? Could they be chicks of last year's brood?)

(5) 14th January 1949.—Nests very conspicuous. Birds busy collecting straw. A number of chicks dead and dying on the ground. Some adults lacked a few of the flight feathers. Most had dark stain on underparts. Hot day but birds made no conscious attempt to shade chicks. Chicks had just started growing wing feathers. Noise in pelicanry much greater than in November.

(6) 12th February 1949.—Very few adults seen which were not on a nest or near one. Non-breeding birds seemed to be absent. Noise and movement had increased considerably. Birds busy gathering twigs for nest repair. A good many chicks grown to 2/3 adult size.

(7) 12th March 1949.—Very hot. By 9 a.m. heat waves and haze. Large flocks of adult birds sitting idly in fields, and gasping. Most adults had changed completely in appearance. Very few remained on trees. Both parents seemed to go out for food. Chicks almost full-grown. A few could fly. Others flapped wings and practised. Half a dozen nests contained small chicks; each nest guarded by an adult bird. On one nest tight sitting bird suggested presence of eggs. Even chicks which could fly well were fed by parent. Adult arrived on what must have been the nest tree, waited for chicks which flew up in a few seconds and fed them.

Most of the birds typical of this area can be seen in the pelicanry. The presence of the pelicans does not seem to affect them in any way. As has been pointed out already the number of Brahminy kites is abnormal and their way of life odd. Till about February House and Jungle Crows haunt the sanctuary in flocks to feed on the fallen eggs and chicks. King Crow, Indian Roller, the Egrets, Pond Heron, Green and Blue-tailed Bee-eaters, Common Myna, Indian Oriole, Rufous-tailed Finch Lark, Ashy-crowned Finch Lark and Bush Chat were common birds. Less common were the Shikra (—feeding full-grown chick on garden lizard—April 1948) and the Palm Swift. When there is water in the fields Green and Common Sandpipers and Red-wattled Lapwings were quite common. Once a Tawny Eagle (?) sat on a tree very near another full of pelicans. Open-bills in very large flocks were seen going over the sanctuary four or five times. A pair of White Ibis, a pair of King Vultures, a Little Cormorant were other birds seen just once. In the tank near Sarepalle, where pelicans occasionally go for weeds, a flock of Blue-winged Teal was seen once. Cotton Teal and Cormorant were always to be found here. In 1949 a flock of Lesser Whistling Teal used to float about invariably in the Ganapavaram or Sarepalle tank. Indian Orioles, Common Mynas, Crows, and Brahminy kites nested on trees in the pelicanry itself. Birds of the undergrowth like the Warblers were never found; nor was any kind of babbler seen in the area. This was of course due to the lack of bushes and grasses. Though palmyra trees were in abundance Palm Swifts were rarely seen. This was found to be a special feature of the whole area and not of the pelicanry alone.

It remains now to thank a few kind friends like my colleagues, Mr. V. Satyanarayanamurthi, M.SC., and Mr. V. Sreeramamurthi, M.SC., of the Arts College who accompanied me the first time and efficiently tapped the villagers for information. To Mr. B. M. Thirunaranan, B.A. (HONS.) (LONDON.), Lecturer in Geography, Government Training College, Rajahmundry, my debt of gratitude is immense. He accompanied me on my second visit and right through he made innumerable suggestions of the greatest importance. My thanks are also due to the authorities of the Bombay Natural History Society who willingly helped me with suggestions and information whenever possible

SOME INTERESTING PLANTS FROM ORISSA

BY

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The plants referred to in the following pages formed part of the collections made by Dr. H. F. Mooney, C.I.E., I.F.S., during his numerous botanical tours in Orissa, including the Eastern States. These collections he invariably sent to the Herbarium of the Forest Research Institute, Dehra Dun, either for identification or confirmation of his determinations. The collection being from a region, the flora of which is still insufficiently known, naturally contained material of considerable interest.

Apart from such general works as the 'Flora of British India' by Hooker or 'Indian Trees' by Brandis, the flora of Bihar and Orissa is known to the outside world chiefly from Haines's 'Botany of Bihar and Orissa', which it might be mentioned, was completed in 1925—some twenty five years ago.

Haines, however, was best familiar with the British districts and above all with Chota Nagpur. It is true that the late Messrs. Grieve and Cooper supplied him with specimens and notes from the various States, but much of the area remained botanically unexplored; of course, this is not at all surprising taking into account the vast extent of the region and the virtual absence of communications at that time.

Dr. Mooney has been Chief Forest Adviser to the Eastern States for several years, during which period he availed himself of the opportunity and collected assiduously and naturally his collections include a large number of plants not previously recorded by Haines. As these are in the neighbourhood of some 85 species it seems worth while publishing an account of them.

In the following pages 85 species including one new species of *Dimeria*, the technical description of which will, however, appear elsewhere, belonging to 67 genera and 33 families are enumerated. The sequence of families and genera is that adopted by Sir J. D. Hooker in the Flora of British India. The generic and specific names have, however, been adopted, as far as practicable, in accordance with the latest international rules of botanical nomenclature, but where changes have occurred the synonym as it appears in Hooker's Flora of British India, is given.

From the field notes and the material collected by Mooney it is clear that the Eastern States and particularly the Kalahandi State, a remote tract of wild hill country adjoining the Eastern Ghats, are of considerable interest botanically and would repay closer botanizing and study. It is in this tableland that a definite transition from a northerly to a southerly type of vegetation becomes markedly perceptible, many of the species collected being found in the Eastern Ghats or even further south. There is little doubt that further investigations may bring to light a larger number of species having an affinity with South Indian flora.

In conclusion, it is my pleasant duty to thank Dr. H. F. Mooney for having supplied the rich material which forms the basis of this paper, in which new records of species already mentioned by Mooney in Indian Forest Records (New series), Botany, Vol. 3 No. 2 (1941) have not been included.

ANNONACEAE

Alphonsea madaraspatana Bedd.; Hk. f., Fl. Br. Ind., 1:89, 1872.

Hitherto known from the Eastern Ghats.

Naraj at the head of the Mahanadi Delta, Cuttack district, Orissa, 12-6-1949, H. F. Mooney 3427 !. A small spreading tree growing from cleft in rock overhanging river at P.W.D. Inspection Bungalow.

POLYGALACEAE

Securidaca inappendiculata Hassk., Pl. Jav. Rar. 295, 1848. *S. tavoyana* Wall.; Hk. f., Fl. Br. Ind., 1:208, 1872.

Hitherto reported from Assam, Sylhet, Chittagong & Burma.

'Jola, 2,100 ft., Pal Lahara State, Orissa, Sept. 1948, H. F. Mooney 2993 !. A large woody climber.'

CARYOPHYLLACEAE

Polycarpaea aurea Wight & Arn. in Ann. Nat. Hist. Ser. 1. 3 (1839) 91; *P. corymbosa* Lamk. var. *aurea* Wight; H.K. f. Fl. Br. Ind. 1:1874, 245.

Previously known from the Deccan hills, in rocky places.

'Sonabera, 2,150 ft., Khariar, West Sambalpur, Orissa, 29-9-1949, H. F. Mooney 3653 !. In Crevices of bare quartzite.'

RUTACEAE

Merope angulat (Willd.) Swingle in Journ. Wash. Acad. Sci. 5:423, 1915; Tanaka in Journ. Ind. Bot. Soc. 16:233, 1937. *Citrus angulata* Willd., Sp. Pl. 3:1426, 1801. *Paramignya angulata* (Willd.) Kurz in Journ. As. Soc. Beng. 44: 135, 1875 et For Flora Burma 1:194,. 1877. *P.longispina* Hk. f., Fl. Br. Ind., 1:511, 1875; Brandis, Indian Trees, 122, 1906. *Atalantia angulata* (Willd.) Engl. in Naturl. Pflanzenfam. 19a: 330, 1931.

This rare species of tidal forests and mangroves is so far reported from Bengal (Sunderbans), Burma, Malaya, Java, New Guinea and the Philippines.

'Jambu, Mahanadi Delta, Cuttack district, Orissa, 5-6-1949, H. F. Mooney 3372 !. In mud on bank of tidal creek.'

This remarkable plant, the only species of the genus *Merope*, has got quite an array of synomyms, the most important of which I have given above. As none of the Indian works consulted give a correct or complete description of the plant, it is given below.

A small tree or large shrub growing on the seashore in tidal forests or mangrove swamps; twigs with stout (.5-1·5 in.) spines, paired or single in the axil of leaves. Leaves simple, thick, coriaceous, alternate, inconspicuously veined, elliptic or elliptic-oblong, 3-5 in. long, 1-1·5 in. broad; petiole short, wingless. Flowers small, white, borne singly or in pairs (very rarely in few-flowered clusters) in the axils of leaves. Calyx cupulate, 5-lobed. Petals 5 imbricate, oblong-lanceolate, acute. Stamens 10, free; anthers linear as long as or longer than the filaments. Ovary stalked on a rather tall disk, ovoid, 3-5-celled with 4 pendulous ovules in each cell. Fruit strongly angled, triangular in cross section, 1-2 in. long, cells filled with a sticky, mucilaginous fluid. Seeds very large flattened, reniform, caudate at the tip where attached, borne one in a segment and immersed in a glutinous, mucilaginous fluid.

This singular genus which is widely scattered over the East Indies in brackish swamps is outstanding because of its characteristic fruit containing very long seeds. It is a highly specialized genus of the subtribe *Triphasiinae*

and is related to *Paramignya* Wight & *Pamburus* Swingle (Type species *Limonia missionis* Wight=*Pamburus missionis* (Wight) Swing. from Talaar Madras Presidency).

MELIACEAE

Xylocarpus gangeticus C. E. Parkinson in Ind., Forester 60:140, 1934. *Carapa moluccensis* Lamk. var. *gangetica* Prain in P. Bot. Surv. Ind., 2:292, 1903.

Hitherto known from the Sunderbans, Burma, Malaya and the Andamans.

'In tidal forest on bank of Jambu river, Jambu, Mahanadi Delta, Cuttack district, Orissa, 6-6-1949, H. F. Mooney 3388!'

In herbarium specimens this species closely resembles and may easily be confused with *X.granatum* Koenig (*Carapa obovata* Bl.) but in the field it is easily distinguished by its characteristic bark, which is dark coloured and rough with longitudinal fissures exfoliating in oblong flakes, and small buttresses and the pneumatophores which sometimes extend up the base of the small buttresses. Further it has a smaller fruit (3-4 in. in diameter) with fewer seeds, than that of *X.granatum*. From *X.moluccensis* Roem. it is easily distinguished by the shape of the leaflets.

LEGUMINOSAE

Crotalaria umbellata Wight in Wall. Cat. 5383. *C.nana* Burm.; Hk. f., Fl. Br. Ind., 2:71, 1876 in part.

So far reported from the Western Ghats, in the hills from South Kanara and Mysore southwards, up to 6,000 ft.

'Sirkagutu plateau, 3,000 ft., Keonjhar State, Orissa, 4-10-1946, H. F. Mooney 2805!. In open pasture.'

Crotalaria retusa Linn.; Hk. f., Fl. Br. Ind., 2:75, 1876.

Proviously recorded from various parts of India but not from Orissa.

'Near Kharpura in Sonpur State, Orissa, 21-3-1944, H. F. Mooney 2402!' 'Anandpur, about 150 ft. Keonjhar State, Orissa, 11-3-1948, H. F. Mooney 2998!'

Indigofera trifoliata Linn.; Hk. f., Fl. Br. Ind., 2:96, 1876.

Hitherto reported from various parts of India but not from Bihar and Orissa.

'Chanlipat, 3,500 ft., Jashpur State, Orissa, 29-9-1941, H. F. Mooney 1888!. Abundant in open grassy banks in Sal forest.' 'Near Pipokhri, 2,500-3,000 ft., Keonjhar State, Orissa, H. F. Mooney 2759!'

Indigofera wightii Grah.; Hk. f., Fl. Br. Ind., 2:99, 1876.

Known so far from Peninsular India and Ceylon.

'Khondalita, Kindiripadar, 2,700 ft., 1-6-1944, H. F. Mooney 2524!. In scrub 'Sal' by road. Very hispid hairy. Flowers bright red.'

Tephrosia roxburghiana J. R. Drummond in Gamble, Fl. Madras 1:1918, 319.

Hitherto reported from the Deccan Peninsula.

'Sonabera, 2,150 ft., Khariar, West Sambalpur, Orissa, 28-9-1949, H. F. Mooney 3645!. In open grass land on shallow sandy soil overlying quartzite.'

Galactia longifolia Benth. in Ann. Wien. Mus. 2:127, 1838. *G. tenuiflora* W. & A. var. *lucida* Baker in Hk. f., Fl. Br. Ind., 2:192, 1876.

Previously recorded from the Western Ghats, in the hills of Coimbatore, the Nilgiris and Pulneys up to 3,000 ft.

'Rairakhol State, Orissa, 10-9-1943, H. F. Mooney 2310!' 'Pankonja Ghat. 3,050 ft., Kashipur, Kalahandi State, Orissa, 24-5-1944, H. F. Mooney 2,500! By road side scrambling among rocks'. 'Sapua forest, Khandpara State, Orissa, 12-8-1946., H. F. Mooney 2689!'

Alysicarpus rotundifolius Dalzell. *Desmodium rotundifolium* Baker in Hk. f. Fl. Br. Ind. 2:172, 1876.

Hitherto reported from the plains of Konkan.

'Bailadela hill, 2,000-4,000 ft., Bastar State, 4-10-1940, H. F. Mooney 1418!'

This plant was placed in the genus *Alysicarpus* by Dalzell and rightly so, as the pods are somewhat turgid and resemble the pods of that genus, but the calyx is not glumaceous and the corolla is considerably exserted. As a matter of fact this and the following species stand intermediate between the genera *Alysicarpus* and *Desmodium* and indicate that probably they are not naturally separable. But wherever these species be placed *Alysicarpus belgaumensis* Wight and *A.racemosus* Benth. must accompany them, since there is no doubt that they are all congeneric.

Alysicarpus parviflorus Dalz. in Hook. Kew Journ. 3:211, 1851; *Desmodium parviflorum* Baker in Hk. f., Fl. Br. Ind. 2:172, 1876.

Hitherto known from the Western Ghats and Konkan.

'Taj Bandh Mali, 3,500 ft., Kalahandi, Orissa, 20-12-1948, H. F. Mooney 3185!. Flowers bright red, turning purple and blue on drying.'

This species forms a connecting link between the genera *Alysicarpus* and *Desmodium* and might with equal force be placed in either. The corolla is hardly exserted and the calyx is not glumaceous. Leaves 1-and 3-foliolate, intermixed.

Cynometra mimosoides Wall.; Hk. f., Fl. Br. Ind. 2:267, 1878, in part.

Previously known from the Andamans, Burma, Sunderbans and the Western Ghats.

'Jambu, Mahanadi Delta, Cuttack district, Orissa, 6-6-1949, H. F. Mooney 3392!. Fairly common on the sandier soils along the fringe of the tidal forest community. Local name—Singhara.'

A small evergreen tree with lenticellate branches; fruit (pod) pale brown, compressed, curiously wrinkled, beaked.

ROSACEAE

Pyrus pashia Buch-Ham.; Hk. f., Fl. Br. Ind. 2:374, 1878.

Known from temperate Himalaya from Kashmir to Bhotan, Khasia Hills, Manipur and Burma.

'In Mancheri valley near Laliya and also in Kamaleswar Valley, about 3,600 ft., Surguja State, Orissa, 3-6-1943, H. F. Mooney 2230!'

HALORAGACEAE

Myriophyllum intermedium DC.; Hk. f., Fl. Br. Ind. 2:433, 1878.

Hitherto known from the Nilgiris, 7,000 ft.; Deccan Peninsula.

'Nawadit, Samri Pat, 3,700 ft., Surguja State, Orissa, 17-3-1947, H. F. Mooney 2845!. Aquatic, rooting in water.'

RHIZOPHORACEAE

Bruguiera parviflora W. & A.; Hk. f., Fl. Br. Ind. 2:438, 1878.

Hitherto known from the tidal forests of the Sunderbans, Andamans and Tenasserim.

'In tidal forest on bank of Jambu river, Jambu, Mahanadi Delta, Cuttack district, Orissa, 6-6-1949. H. F. Mooney 3381!'

LYTHRACEAE

Sonneratia alba Sm.; Hk. f., Fl. Br. Ind. 2:580, 1879.

Previously known from the Andamans, Burma (Pegu and Mergui) and East Godavari district.

'Jambu, Mahanadi Delta, Cuttack district, Orissa, 6-6-1949, H. F. Mooney 3379!. Bank of creek in tidal forest. Local name Urva.'

This species in herbarium specimens looks very much like *S.caseolaris* (Linn.) Engl. (*S.acida* Linn. f.) but differs from it chiefly in the absence of petals. Haines in his flora p. 376 regarding *S.acida* Linn. f. says 'The tree was not in flower and the flower is described from a Bombay specimen.' It

is, therefore, fairly certain that the species of *Sonneratia* occurring in the tidal forest of the Mahanadi Delta is *S.alba* Sm.

AIZOACEAE

Sesuvium portulacastrum Linn.; Hk. f., Fl. Br. Ind. 2:659, 1879.

Hitherto known from various parts of India (on sea-shore) from Bengal, Burma, Bombay and Madras, but not from Bihar and Orissa.

'On the bank of tidal river at Jambu. Mahanadi Delta, Cuttack district, Orissa, 6-6-1949, H. F. Mooney 3395 !. A prostrate, fleshy herb, leaves oblong-spathulate, 2 inch long.'

Trianthema crystallina Vahl.; Hk. f. Fl. Br. Ind. 2:1879, 660.

Hitherto known from various parts of India but not reported from Bihar and Orissa.

'Bank of Kendrapara Canal among bushes at Tanki Belari, Mahanadi Delta, Cuttack district, Orissa, 9-6-1949, H. F. Mooney 3419 !'.

Gisekia pharnaceoides Linn.; Hk. f., Fl. Br. Ind. 2:664, 1879.

Hitherto known from the drier parts of India from the Punjab and Sindh to Ceylon.

'Jambu, Mahanadi Delta, Cuttack district, Orissa, 7-6-1949, H. F. Mooney 3403 !. On sandy ground in the open.'

UMBELLIFERAE

Trachyspermum stictocarpum (Cl.) Wolff in Engler, Pflanzenreich, iv. 228: 89, 1927. *Carum stictocarpum* Cl. var. *hebecarpa* Cl. in Hk. f., Fl. Br. Ind. 2:682, 1879.

So far known from the Central Provinces and Konkan.

'Kalahandi State, 1,500-3,000 ft., Orissa, Dec. 1939, H. F. Mooney 1192 !'

Although Haines mentions this species he actually never collected it from the area.

Pimpinella heyneana Wall.; Hk. f., Fl. Br. Ind. 2:684, 1879.

Previously recorded from Chittagong, Burma and Peninsular India.

'Kiapodar, 1,350 ft., Kalahandi, Orissa, 18-12-1946, H. F. Mooney 3172 !. On shady banks of large streams.'

RUBIACEAE

Argostemma verticillatum Wall.; H.K. f. Fl. Br. Ind. 3:1880, 43.

Known from temperate Himalaya, from Kumaon to Sikkim.

'Gandamardan Hill, 1,200-3,000 ft., above Narsinghnath, West Sambalpur, Orissa, 5-10-1949, H.F. Mooney 3700 !. On shady side of moist moss-covered rocks, common above 2,000 ft.'

Oldenlandia umbellata Linn.; Hk. f., Fl. Br. Ind. 3:66, 1880.

Hitherto known from Circars, Deccan and Carnatic.

'Balukhand, Puri, Orissa, 16-5-1948, H. F. Mooney 3021 !. Frequent on moist shady bank along Sar Lake 'Cut'.'

Oldenlandia trinervia Retz.; Hk. f., Fl. Br. Ind. 3:66, 1880.

Hitherto known from Chittagong, Burma and Peninsular India.

'Balukhand, Puri, Orissa, 25-5-1948, H. F. Mooney 3035 !.

On moist shady bank at sea level along Sar Lake 'Cut'. An erect herb, 2-4 in. high with 4-angled stems.'

Anotis monthoioni Hk. f. in Hk. f., Fl. Br. Ind. 3:73, 1880.

Previously recorded from Western Ghats, Mysore and Canara to Malabar.

'Sirkagutu, 3,100 ft., Keonjhar State, Orissa, 3-10-1946, H. F. Mooney 2784 !. On shady bank by forest path in forests'.

COMPOSITAE

Dichrocephala latifolia (Lamk.) DC.; Hk. f., Fl. Br. Ind. 3: 245, 1881.

Hitherto known from the tropical and subtropical Himalaya from Simla to Sikkim, Khasia hills; Western Peninsula on the Ghats from Bombay southwards.

'Sagbari, 2,750 ft., Kalahandi State, Orissa, 24-5-1944, H. F. Mooney 2499 !. In moist situation under shade.'

Blumea bifoliata DC.; Hk. f., Fl. Br. Ind. 3:260, 1881.

Known from various parts of India but not from Bihar and Orissa.

'Nayagarh, 350 ft., Nayagarh State, Orissa, 12-3-1943, H. F. Mooney 2210 !. Along edges of ricefield.'

Acanthospermum hispidum DC., Prod. 5:522, 1836.

A hairy dichotomously branched erect annual herb, 1-2 ft. high. Leaves opposite, sessile, obovate, spathulate, serrate, hairy on both surfaces, 1½-3 in. long. Flower heads about ⅓ in. in diameter when young, spreading to ½ in. at maturity, placed at the base of the forking branches and consist of two kinds of florets, the outer female and rayed, the inner male and tubular. Peduncle hairy, very short. Female florets about 5-7, developing into achenes that stand radially. Achenes bristly and having a pair of horn-like spines at the top. Disk florets 6-7, tubular, yellow. Stamens 5, with united anthers and free filaments. Ovary inferior, infertile. Pappus absent.

This pernicious weed is a native of South America and is of recent introduction into this country. It is reported by Gamble (Flora of Madras) from S. Canara and Salem districts and is now common in Malabar, Coimbatore etc. It is a pest in Udaipur State, C. P. which is very close to the western boundary of our area.

Recently Mooney has collected it on the Main Pat in Surguja. Flowers March-April, Fruit Oct-Dec.

Galinsoga parviflora Cav.; Hk. f., Fl. Br. Ind. 3:311, 1881.

An introduced American weed now known from various parts of India.

'Samri; 3,800 ft., Surguja State, Orissa, 17.3.1947, H. F. Mooney 2852 !'

Crassocephalum crepidioides (Benth.) S. Moore in Journ. Bot. 50:211, 1912. *Gynura crepidioides* Benth. in Hook., Niger Fl. 438, 1849; Bor in Curr. Sc. 7:116, 1938.

'Purnaguma, 2,000 ft., Karlapat, Kalahandi, Orissa, 19-12-1946, H. F. Mooney 3177 !. On shady bank in road cutting in moist situations. Flowers red or deep orange.'

'Indra Giri, about 3,700 ft., Kasipur, Kalahandi, Orissa, 27-1-1949, H. F. Mooney 3250 !. Open grassland and among *Phoenix* bushes.'

An erect succulent usually much branched annual herb, about 2-3 ft. high. Stem and branches pubescent or nearly glabrous. Leaves alternate, spathulate usually deeply lyrate—pinnatifid, sometimes not lobed, mostly petiolate, the upper ones rarely sessile, 1-10 in. long; lobes acutely dentate, almost glabrous. Capitula oblong, ⅓—½ in. long, on long slender pedicels, in a dense or lax corymbose cyme, rarely solitary. Disk hairy with filiform bracts below. Involucral bracts about 15, linear-subulate, glabrous or slightly setulose. Florets all tubular, hermaphrodite or rarely a few outer ones female, limb 5-toothed. Corolla orange-yellow or tinged with purple, shorter than or equalling the pappus. Style-branches slender, tips long, subulate, hispid. Anther-bases entire or subauricled. Achenes narrow, many ribbed; pappus hairs copious, fine, white.

This species, which is a native of tropical Africa, was first observed by Bor in the plains of Assam at Charduar in 1931. Since then it has spread all over Assam and various parts of Bengal. It has also been reported from Burma (Parkinson 15665), Darjeeling (Aaizada 18558), Bastar State (Mooney 2591) and Dehra Dun (Raizada !). In Dehra Dun it made its first appearance about 1940 and is since then invading plantations and getting naturalized. One

factor which has undoubtedly a very important bearing on its distribution is its capacity for producing flowers and fruits all the year round as well as its tolerance towards very diverse edaphic conditions.

LOGANIACEAE

Mitrasacme polymorpha R. Br.; Hk. f., Fl. Br. Ind. 4: 80, 1883.

Known from Nepal, C. P., Deccan Penninsula etc.

'Tangula, 2,200 ft., Pal Lahara State, Orissa, 9-10-1946, H. F. Mooney 2826 !. Frequent in open Sal jungle !

GENTIANACEAE

Exacum pumilum Griseb.; Hk. f. Fl. Br. Ind. 4:1883, 98.

Hitherto known from the Konkan and Anamalai Hills.

'Supkon Dongar, 2,400-2,900 ft., Sonabera plateau, Khariar Estate, West Sambalpur, Orissa, 30-9-1949, H. F. Mooney 3666 !. Under shade of tall grasses on dry sandy soils overlying shale and sandstone. A very slender delicate herb with bright blue flowers.'

Hoppea fastigiata C. B. Clarke in Hk. f., Fl. Br. Ind. 4: 100, 1889.

So far known from Peninsular India.

'Sinkagutu, 3.000 ft., Koenjhar State, Orissa, 3-10-1946, H. F. Mooney 2789 !. Abundant in open grass land, especially in damper localities.'

Canscora sessiliflora R. & S.; Hk. f. Fl. Br. Ind. 4:1883, 104.

Previously recorded from the Deccan Peninsula—N. Circars and Carnatic.

'Mundkati, 700 ft., Barapahar, West Sambalpur, Orissa, 16-9-1949, H. F. Mooney 3588 !. In the open on sandy soil overlying sandstone.'

SOLANACEAE

Physalis minima Linn.; Hk. f., Fl. Br. Ind. 4:238, 1883.

Known from various parts of India.

'Kandadhar hill, 3,250 ft, Koenjhar State, Orissa, 4-10-1946, H. F. Mooney 280 !. By path in Sal forest.'

Reported by Haines to have been collected from Chota Nagpur.

SCROPHULARIACEAE

Mecardonia dianthera (Sw.) Pennell in Proc. Acad. Nat. Sci., Philadelphia 98:87, 1946. *Bacopia chamaedryoides* (H.B.K.) Wettst. in Engler et Prantl, Natur. Pflanzenf. 4:36, 1891. *Herpestis chamaedryoides* H.B.K., Nov. Gen. et. Sp. 2:369, 1818. *Lindernia dianthera* Swartz, Prod. Veg. Ind. Occ. 92, 1788.

'Near Nawadit on Samri Pat, Surguja State, 17-3-1947, H. F. Mooney 2849 !. Abundant and wide spread on grassy banks and in open grass land above 3,600 ft.'

An annual, diffuse, decumbent, glabrous herb; branches few from the base, 6-12 in. long, prostrate or ascending, often rooting at the lower nodes; stem 4-angled. Leaves opposite, decussate, almost sessile, ovate, rounded, crenate-serrate, subacute or obtuse, rounded and at times unequal-sided at the base, glabrous above, minutely dotted on the under surface, unicostate, midrib sparsely branched. Flowers solitary, axillary, bisexual, zygomorphic; pedicel ·25-·5 in. long, as long as or longer than the flower, 3-sided; bracteoles 2, arising from the base of the pedicel, ·1-·12 in long, linear lanceolate. Calyx ·25 in. long, green, glabrous, nearly as long as the corolla, persistent, free (or almost 5-partite?). Sepals 5, free, unequal, posterior and the two anterior ovate, 3-5-veined, the two lateral linear, 1-veined, enclosed by the larger outer sepals; frequently one lateral sepal, usually the right one, rarely the left one, or both, provided with a green, linear, basal appendage, which projects beyond the outer sepals and is bent towards the pedicel; all the sepals are somewhat enlarged in fruit and persist after dehiscencee and shedding of the seed. Corolla gamopetalous, bilabiate, very shortly exserted, yellow with purple veins, the colour of the

veins most intense towards the posterior side, gradually decreasing in intensity towards the anterior side, the veins of the anterior petal almost colourless; corolla-tube almost cylindric, neither saccate, nor spurred or plaited, nearly as long as the calyx; lobes small; upper lip outermost in bud, emarginate (notched); lower lip 3-lobed, lobes spreading, the anterior slightly notched; a tuft of hairs on the posterior side in the throat of the corolla. Stamens 4, didynamous, arising from the base of the corolla-tube, included; filaments slender, filiform; anther-cells roundish, separate, stipitate, dehiscing by longitudinal slits. Disk prominent, hypogynous, greenish-yellow. Gynoecium bicarpellary, syncarpous; ovary superior, 2-celled, with numerous ovules; style slightly dilated at the top but not winged, curved towards the anterior side of the flower near its apex; stigma entire, blunt. Capsule ·25 in. long smaller than the enclosing persistent calyx, cylindrical, 2-valved, septifragal; valves entire or slightly notched at the tip. Seeds numerous minute; testa reticulate, with light brown meshes and dark brown net-work.

The only previous record of this species is from Bengal (Prain, Bengal Plants 2 (1903) 765 and Rec. Bot. Surv. Ind. 3. No. 2. (1905) 257. It is not mentioned by Voigt (1845), who completed his account of the Calcutta plants in 1843 or Hooker in Flora of British India the last volume of which was published in 1897. Bruhl (Journ. and Proc. As. Soc. Beng. n.s. 4 (1910) 629) therefore concludes that this species was probably introduced in this country after 1897. There is also no record of this species by Haines in his Botany of Bihar and Orissa. Recently, however, Raizada has collected it from Benares and Dehra Dun. It is a native of America.

Adenosma microcephalum Hk. f., in Fl. Br. Ind, 4:264, 1884.

Hitherto known from Burma (Tenasserim) and Cambodia.

'Near Aurar Village, 2,300 ft., Sonabera plateau, Khariar, West Sambalpur, Orissa, 3-10-1949, H. F. Mooney 3696 !. Under shade of quartzite boulder on dry rocky outcrop.'

OROBANCHACEAE

Aeginetia peduncuiata Wall.; Hk. f., Fl. Br. Ind. 4:320, 1884.

Known from various parts of India but not definitely reported from Bihar and Orissa.

'Khariar, Sonabera plateau, 2,100-2,400 ft., West Sambalpur, Orissa, 30-9-1949, H. F. Mooney 3668 !. Parasitic on *Themeda* spp. and fairly common on Sonabera plateau, where it was seen several times.'

Although mentioned by Haines in his Botany of Bihar and Orissa p. 642, it has never hitherto been collected from that area.

LENTIBULARIACEAE

Utricularia striatula Sm. in Rees Cycl. 37: n. 17, 1819. *U.orbiculata* Wall. Hk. f., Fl. Br. Ind. 4:334, 1884.

Hitherto known from various parts of India but not from Bihar and Orissa.

'Sirkagutu 2,500 ft., Keonjhar State, Orissa, 2-10-1946, H. F. Mooney 2766 !. Growing on moist rock.'

GESNERACEAE

Epithema carnosum Benth. var. **hispida** Clarke; Hk. f., Fl. Br. India 4:369, 1884.

Previously known from the Western Ghats, Nilgiris and Tinnevelly hills.

'Kapilas forest, 1,000 ft., Dhankanal State, Orissa, 16-9-1942, H. F. Mooney 2067 and 2724 !. A succulent herb growing among moss on rocks in valley close to stream'.

ACANTHACEAE

Strobilanthes pulneyensis ? Clarke in Hk. f., Fl. Br. Ind. 4:438, 1884.

So far known from the Western Ghats, Coorg, Nilgiris, Pulney hills etc.

'Karlapat. 2,400 ft, Kalahandi State, Orissa, 24-12-1939, H. F. Mooney Dehra Dun Herb. No. 83738 !. In glen.'

'Chandragiri, 3,200 ft., Kalahandi State, Orissa, Jan. 1938, H. F. Mooney Dehra Dun Herb. No. 83075 !'

These specimens were identified by Mr. V. Narayanaswami at the Calcutta Herbarium as *S.neilgherrensis*. Bedd. var. but to me they appear to be closer to *S.pulneyensis* Cl., the flattened heads being a very distinctive character and also shape of the bracts, which are not narrow-oblong. In all probability it is a variety intermediate between the two species and indicates that the two species are not specifically distinct. Further field investigation is, however, necessary to confirm the above conclusions.

Haplanthus verticillatus Nees; Hk. f., Fl. Br. Ind. 4:506, 1884.

Hitherto known from C.P. and the Western Peninsula.

'Tej Band Mali; 3,300 ft., Kalahandi State, Orissa, 20-12-1948, H. F. Mooney 3183 !'

VERBENACEAE

Avicennia marina (Forsk.) Vierh. in Denkschr. Akad. Wien. 71:435, 1907.

Hitherto known from the Sunderbans, Burma, Andamans and the Deccan Peninsula in tidal waters and salt swamps.

'In mud on bank of tidal creek at Jambu, Mahanadi Delta, Cuttack district, Orissa, 6-6-1949, H. F. Mooney 3394 !'

LABIATAE

Platystoma africanum. Beauv., Fl. Owar. 5:61 t. 95, fig. 2., 1802. *P. flaccidum* Benth; Hk. f., Fl. Br. Ind. 4:611, 1885.

Previously reported from Dharwar, N. Canara and Mysore.

'Pipokheri, 300 ft., Keonjhar State, Orissa, 10-10-1946, H. F. Mooney 2755 !. A herb common in forest, flowers very pale blue'.

AMARANTACEAE

Gomphrena celosioides Mart., in Nov. Act. Nat. Cur. 13:301, 1826.

'Golapalli, 400 ft., south of Bastar State, Orissa, 6-1-1943, H. F. Mooney 2147 !. Very local on open heavily grazed and trodden grass-land near Range Quarters.'

An annual or perennial, much branched, prostrate or procumbent herb. Tap root stout, very long. Branches densely clothed with adpressed or spreading long white hairs; nodes swollen. Leaves opposite, shortly stalked, entire, oval-oblong, spathulate or oblong-elliptic, 1-2 in. long, attenuate at the base, glabrous above, covered with long white shaggy hairs beneath. Flowers in dense cylindrical, solitary, terminal or axillary spikes ·5-1·5 in. long. At the base of each spike are two small leaves. Flowers hermaphrodite, dull white, compressed, each with one bract and two bracteoles. Bract short, membranous, ovate, acute, at times denticulate, persistent; bracteoles as long as the flower, boat shaped, white, membranous and shortly winged on the back at the top. Perianth 5-partite covered with dense white wool, the 2 inner lateral segments larger, concave, woolly, perfectly green along the middle, the 3 outer ones transparent, scalelike, woolly at the base only. Staminal-tube long, 5-fid, anthers yellow, 1-celled, filaments united into a long tube. Style short, 2-lobed. Fruit enclosed by the hardened perianth. Seed small, somewhat compressed shining, reddish-brown or orange-red, falling away from the fruit on ripening.

Native of S. Brazil, Paraguay, Uruguay and Argentine, of very recent introduction but now very rapidly spreading and becoming a troublesome weed on lawns.

Till recently this species was erroneously identified as *Gomphrena decumbens* Jacq. or *G. dispersa* Standley. It can, however, be distinguished from both these species, by the very narrow, often obscure, and entire or scarcely toothed crest on the keel of the bracteoles, which is broadest and appears to rise at some distance below the sharply acute apex. Moreover *G.decumbens* differs in having the bracteoles often tinged with pink and much longer than flowers; while *G. dispersa* has the conspicuous crests of the bracteoles widest at or

near the apex so that the flowers have an obtuse facies. Each of these species has a more northern distribution in tropical America, namely in Mexico and around the Caribbean Sea. There can, of course, be no possibility of confusion of *G.celosioides* with the commonly cultivated garden *G.globosa* Linn. which has wider, globose, variously coloured heads.

Flowers practically throughout the year.

A native of S. Brazil, and of very recent introduction into this country. I have also collected or seen it from Dehra Dun, Delhi, Allahabad, Ajmer, Ranikhet, Madras, Coimbatore etc.

Psilotrichum ferrugineum Moq.; Hk. f., Fl. Br. Ind. 4:725, 1885.

Known so far from Bengal.

'Near Sonkardih, 2,000 ft., Keonjhar State, Orissa, 5-10-1946, H. F. Mooney 2816 !. In Swampy ground.'

Alternanthera pungens H.B.K., Nov. Gen. et Sp., 2:206, 1817. *A. echinata* Sm., in Rees Cycl. 39: Supp. n. 10, 1819.

'Champua, 1300 ft., Keonjhar State, Orissa, Nov. 1948, H. F. Mooney 3124 !. In grass.'

A prostrate spreading biennial herb. Stem zig-zag, slightly tinged with pink, covered all over with shaggy hairs. Leaves simple, opposite, exstipulate very unequal; petiole short somewhat ensheathing at the base; lamina oblong-orbicular or ovate orbicular, entire, narrowed at the base, covered with a layer of very short silky hairs, ½-1 in. across, obtuse or abruptly tipped at the apex. Flowers in heads in the axils of leaves, much compressed and chaffy; heads ⅛-½ in. long. Bracteoles 2. Perianth-segments of 5 unequal, scarious sepals, 1-nerved; the outer 3 larger than the inner 2; the posterior one oblong, obtuse and furnished with a sharp point at the apex; the 2 lateral ones lanceolate, sharply pointed at the apex and becoming spiny in fruit; the 2 inner ones fringed with hairs. Stamens 5, minute, united at the base into a cup and alternate with irregularly toothed processes. Ovary superior, 1-celled, 1-ovuled. Fruit a utricle enclosed by the persistent perianth, the bract and the bracteoles. Seed round, brownish.

A native of tropical America. It was introduced into this country about 1913. This weed was first collected on the Melagiri hills in Salem district, Madras in 1913 and is now rapidly spreading and has already got established in Coimbatore, Bangalore, and Madras. It has also been collected from Bombay by Santapau and from Dehra Dun by Raizada. I have myself seen it growing at Shahadra near Delhi and in the Indian Agricultural Research Institute grounds in New Delhi.

I have been unable to satisfy myself with the correct identity of this plant as its nomenclature is mixed up with taxonomy. Further research is necessary to settle this point.

EUPHORBIACEAE

Jatropha heterophylla Heyne ex Hk. f. in Hk. f., Fl. Br. Ind. 5:382, 1887.

Hitherto known from the Deccan Peninsula.

'On the boundary line of Sal forest near Titlagarh, Balangir Patna, Orissa, 8-7-1949, H. F. Mooney 3454 !. Sub-gregarious in a small patch on the open line and extending some way inside the forest.'

Chrozophora parvifolia Klotzsch ex Schweinf. Pl. quaed. Nilot. 10 (1862); Prain in Kew Bull. (1918) 91; *C.plicata* 2, Hk. f. Fl. Br. Ind. 5:1887, 410.

Previously reported from various parts of India but not from Bihar and Orissa.

'Bhawani patna, 800 ft., Kalahandi, Orissa, 4-8-1949, H. F. Mooney 3564 !. Common in fields on black cotton soil. Two glands at base of leaf-blade.'

URTICACEAE

Ficus foveolata Wall.; Hk. f., Fl. Br. Ind. 5:527, 1888.

Previously known from the outer Himalaya, the Khasia hills, Chittagong and Burma.

'Tangula, 2,200 ft., Pal Lahara State, Orissa, 1-10-1946, H. F. Mooney 2825 !. Creeping on rocks and bases of trees near streams and moist places under shade.'

Lecanthus wightii Wedd.; Hk. f., Fl. Br. Ind. 5:1888, 559 in part.

Previously recorded from various parts of India but not from Bihar and Orissa.

'Slopes of Gandamardan Hill, 2,500-3,000 ft., above. Narsinghnath, West Sambalpur, Orissa, 5-10-1949, H. F. Mooney 3716 !. On moist mossy rocks in shady places.'

Elatostemma surculosum Wight; Hk. f., Fl. Br. Ind. 5:572, 1888.

Known from various parts of India but not recorded from Bihar and Orissa.

'Goyalghati, Pathar valley, 1,000 ft., Kapilas Hills, Dhenkanal State, Orissa, 16-9-1942, H. F. Mooney 2068 !. A small succulent herb growing among moss on rocks.'

ORCHIDACEAE

Aberia grandiflora Lindl.; Hk. f., Fl. Br. Ind. 6:136, 1890.

Previously known from the Western Peninsula.

'Khandual Mali, 3,300 ft., Karlapat, Kalahandi, Orissa, 12-7-1949, H. F. Mooney 3471 !. Abundant in crevices of laterite on plateau in South Kalahandi.'

LILIACEAE

Dipcadi montanum (Dalz.) Baker; Hk. f., Fl. Br. Ind. 6:346, 1892.

Previously recorded from the Bombay Presidency.

'Tejbandh Mali, 3,300 ft., near Gunpur, South Kalahandi, Orissa, 16-7-1948, H. F. Mooney 3091 !. Growing gregariously all over the hill side.'

The specimen quoted above differs in several respects from the description of *D. montanum* (Dalz.) Baker. According to Mooney the flowers are pale vermillion or pale brick red. It is in all probability a var. nov. if not a sp. Nov., but the material sent is insufficient to decide the issue.

COMMELINACEAE

Phaeneilema paniculatum Bruckner in Notiz. Bot. Gart., Berlin 10 (1927) 56; *Aneilema paniculatum* Wall.; Hk. f., Fl. Br. Ind. 6:1892, 381.

Known previously from the Deccan Peninsula.

'Sonabera plateau, 2,100-2,400 ft., Khariar, West Sambalpur, Orissa, 28-9-1949. H. F. Mooney 3641 !. On very shallow sandy soil on bare quartzite rocks in the open. Flowers bright blue.'

Also collected on the summit of Gandamardan Hill, 3,200 ft., above Narsinghnath, Sambalpur district by Mooney 3707 !.

Phaeneilema scaberrima (Bl.) Raizada Comb. nov.; *Commelina scaberrima* Bl. Enum. 1:4, 1827; *Aneilema scaberrimum* Kunth Enum. 4:69, 1843; Hk. f., Fl. Br. Ind. 6:382, 1892.

So far known from the tropical eastern Himalayas and Khasia hills; Western Ghats; Rampa hills and Ceylon.

'Srikuti; 700 ft., Ranpur State, Orissa, 5-10-1942, H. F. Mooney 2106 !. On moist bank under moderate shade in semi-evergreen forest.'

ERIOCAULACEAE

Eriocaulon breviscapum Koern.; Hk. f., Fl. Br. Ind. 6:575, 1893.

Known so far from North Canara.

'Near Koira, 2,000 ft., Bonai State, Orissa, 25-2-1946, H. F. Mooney 2623 !. In running water of perennial streams.'

I am not at all satisfied with the identification of this plant as I am unable to find any reliable character by which to distinguish this species from *E.rivulare* Dalz. The distinguishing characters given by Ruhland in Pflanzenreich are, to my mind, very unsatisfactory.

Eriocaulon echinulatum Mart.; Hk. f., Fl. Br. Ind. 6:579, 1893.

Hitherto reported from Tavoy, Burma.
'Motijharan, 650 ft., Sambalpur, Orissa, 11-12-1947, H. F. Mooney 2987 !. In muddy ground near spring.'

Eriocaulon thwaitesii Koern.; Hk. f., Fl. Br. Ind. 6:583, 1893.

So far known from the Nilgiris and Ceylon.
'Purhaipada, 2,000 ft., Bhuinya hills, Keonjhar State, Orissa, 5-10-1946, H. F. Mooney 2815 !. In open grass land.'

Eriocaulon ritchieanum Ruhland in Pflanzenr. iv. 80:73, 1903; Fyson in Journ. Ind. Bot. Soc., 3:16, 1922. *E.horsley-kondae* Fyson l.c 13. t. 45.

Previously known from the Central Provinces and Peninsular India.
'Nawadit, 3,700 ft., Samri Pat, Surguja State, Orissa, 9-5-1940, H. F. Mooney 1295 !. Growing in stream.'

CYPERACEAE

Fimbristylis polytrichoides (Retz.) Vahl.; Hk. f., Fl. Br. Ind. 6:632, 1893.

Previously known from Bengal and the Deccan Peninsula.
'Marsaghai, Mahanadi Delta, Cuttack district, Orissa, 10-6-1949, H. F. Mooney 3421 !. On slightly elevated patch of sandy ground by edge of rice-field in otherwise low-lying locality.'

Fimbristylis globulosa (Retz.) Kunth; Hk. f., Fl. Br. Ind., 6:644, 1893.

Previously known from Nepal, Assam, Burma and Ceylon.
'Marsaghai, Mahanadi Delta, Cuttack district, Orissa, 3-6-1949, H. F. Mooney 3336 !. In rice-field on heavy clay.'
The specimen quoted above is abnormally small for this species but is, I am sure, correctly named.

Fimbristylis cyperoides R. Br. Var. **cinnamometorum** C. B. Clarke in Hk. f., Fl. Br. Ind. 6:650, 1893.

So far reported from Burma, Bastar State and South India.
'Champabandh Mali, 3,400 ft., Karlapat, Kalahandi, Orissa, 16-7-1949, H. F. Mooney 3505 !. On thin soil over laterite.'

Fuirena uncinata Kunth; Hk. f., Fl. Br. Ind. 6:666, 1893.

So far known from Peninsular India.
'Balukhand, near Puri, 25-5-1948, H. F. Mooney 3034 !. On moist shady bank of the Sar Lake "Cut", sea level.'

Rhynchospora wightiana Steud.; Hk. f., Fl. Br. Ind. 6:669, 1893.

Hitherto reported from Peninsular India.
'Junagarh, 700 ft., Kalahandi, Orissa, 15-12-1948, H. F. Mooney 3165 !. In dry sandy waste land.'

Rhynchospora gracillima Clarke in Hk. f., Fl. Br. Ind. 6:671, 1894.

So far recorded from Khasia hills, Tinnevelly and Ceylon.
'Near Sankiari, 2,500 ft., Jaspur State, Orissa. Sept. 1947, H. F. Mooney. In moist forest glades with small grass and sedges.'

Scleria biflora Roxb.; Hk. f., Fl. Br. Ind. 6:687, 1894.

Previously recorded from Bengal, Assam and Ceylon.
'Motijharan, 600 ft., Sambalpur, Orissa, 3-9-1948, H. F. Mooney 3105 !

This species very closely resembles *S.tessellata* Willd. and may better be considered a variety of it, since the only difference is in the lobes of the disc-margins which are short, ovate, erect, thin, pale in *S.tessellata*, and lanceolate, acute or subulate, erect, stout, ferruginous-brown in *S.biflora*. Roxb.

Scleria zeylanica Poir.; Hk. f., Fl. Br. Ind. 6:687, 1894.

So far reported from Tenasserim, Nicobars & Ceylon.
'Motijharan, 600 ft., Sambalpur, Orissa, 3-9-1948, H. F. Mooney 3103!'

Diplacrum caricinum R. Br., Prod. 241, 1810. *Scleria caricina* Benth., Hk. f., Fl. Br. Ind. 6:688, 1894.

Hitherto known from various parts of India but not from Bihar and Orissa.
'Motijharan, 600 ft., Sambalpur, Orissa, 30-11-1947, H. F. Mooney 3982!. Among grass.'

GRAMINEAE

Panicum auritum Presl.; Hk. f., Fl. Br. Ind. 7:40, 1897.

Reported by Haines from north Bihar (Tarai near Purneah and Monghyr) but so far not recorded from Orissa.
'Sankardih, 1,700 ft., Pauri hill, Bamra, Orissa, 26-6-49, H. F. Mooney 3439!. In mud by edge of perennial pool in stream under shade in Sal forest.'

Pseudoraphis brunoniana Griff., Not. ad. Plant. Asiat. 3:29, 1851. *Chamaeraphis spinescens* Poir. var. *brunoniana* Hk. f., Fl. Br. Ind. 7:62, 1897.

Hitherto known from several parts of India but not from Bihar and Orissa.
'Narsinghpur, Narsinghpur State, Orissa, 5-8-1946, H. F. Mooney 2687!. A floating grass forming a tangled mass in tank.'
'Near Rengli, Sambalpur, Orissa, 16-9-1947, H. F. Mooney 2897!. Grows in ponds.'

Pseudoraphis minuta (Mez) Pilger in Notiz. Bot. Gart, Berlin 10:210, 1928. *Chamaeraphis gracilis* Hack. apud Hk. f., Fl. Br. Ind. 7:62, 1897 (non Hack. in Engl. Bot. Jahrb. 6:236, 1885.)

Previously recorded from Lower Bengal, Assam, and Burma.
'Balukhand, near Puri, Orissa, 25-5-1948, H. F. Mooney 3031!. An aquatic grass growing in water upto about 9 in. deep and on damp ground along the margin of Sar Lake "Cut". Tends to grow in small gregarious patches.'

Dimeria lehmanni Hack.; Hk. f., Fl. Br. Ind. 7:104, 1897.

Hitherto known from Kambakkam hills in South India and Ceylon.
'Sonabera, 2,150 ft., Khariar, Sambalpur district, Orissa, 29-9-1949, H. F. Mooney 3658!'

Dimeria mooneyi Raizada, sp. nov.

'In crevices of bare quartzite at Sonabera, 2,150 ft., Khariar, Sambalpur district, Orissa, 29-9-1949, H. F. Mooney 3,652 and 3657!'
A very distinct species with solitary spikes, close to *D. avenacea* C. E. C. Fischer. Typus Mooney 3657 in Herb. Dehra Dun.

Arthraxon echinatus Hochst. in Flora (1856) 188; *A. spathaceus* Hk. f., in Fl. Br. Ind. 7:1897, 145.

Hitherto known from the Deccan Peninsula and Assam.
'Usakothi valley, 1,000 ft., near Lohra-Behera, Barapahar, West Sambalpur, Orissa, 20-9-1949, H. F. Mooney 3614!. A very diffuse grass up to 24 in. high and rooting at the nodes, on quartzite rocks, under very light shade.'

Arthraxon nudus Hochst. in Flora 1856:188. *A.ciliaris* Beauv. in part; Hk. f., Fl. Br. Ind. 7:146, 1897.

So far known from Assam, Burma, etc.

'Near Kholgaon, 700 ft., Sambalpur, Orissa, 28-10-1947, H. F. Mooney 2933 !. Growing in mixed deciduous forest.'

Coelorachis clarkei (Hack.) Blatter & McCann in Journ. Bom. Nat. Hist. Soc. 32:33, 1927. *Rottboellia clarkei* Hack.; Hk. f., Fl. Br. Ind. 7:156, 1897.

Known so far from the Western Peninsula.
'Kardhana, 3,000 ft., Jaspur State, Orissa, Sept. 1941, H. F. Mooney 1825 !. In moist glade near a stream under light shade.'

Sporobolus pilliferus Kunth; Hk. f., Fl. Br. Ind. 7:251, 1897.

Hitherto known from various parts of India but not from Bihar and Orissa.
'Kardhana, about 3,000 ft., Jaspur State, Orissa, Sept. 1941, H. F. Mooney 1811 !. Abundant on dry, stony upland.'

Tripogon jacquemontii Stapf; Hk. f., Fl. Br. India. 7:286, 1897.

Known from various parts of India but not definitely from Bihar and Orissa.
'Basang Mali, 3,500 ft., Kasipur, Kalahandi State, Orissa 30-5-1944, H. F. Mooney 2518 !. Abundant.'
Although mentioned by Haines on p. 966 he actually never collected it from the area.

Tripogon bromoides Roth; Hk. f., Fl. Br. Ind. 7:287, 1897.

Hitherto reported from the Western Ghats and Ceylon.
'Sonabera plateau, Khariar, Sambalpur dist., Orissa, 15-4-1949, H. F. Mooney. 3299 !. On bare sandstone cliffs at 2,500 ft. and extending to 3,300 ft. on Sonabera plateau but much more abundant.'
The spikes in the specimen quoted above are considerably smutted but in all probability it is correctly named. The lemmas are 4-fid.

Tripogon roxburghianus Bhide in Journ. Proc. As. Soc. Beng. (n.s.) 7:515, 1911 *Lepturus roxburghianus* Hk. f. in Hk. f., Fl. Br. Ind. 7:365, 1896 (fortassis Steudel).

Previously recorded from the Deccan Peninsula.
'Jantiabandh, 3,700 ft., south Kalahandi, Orissa, 17-7-1949, H. F. Mooney 3530. In moist ground close to "dew pond" in laterite or shallow soil forming a dense sward. Gregarious in small patches.'

Eragrostis tenuifolia Hochst.; Hk. f., Fl. Br. Ind. 7:322, 1897.

Hitherto recorded from the Central, Western and Southern India.
'On the Pats 3,000-3,500 ft., Jaspur State, Orissa, Sept. 1941, H. F. Mooney 1891 !. Very abundant on clay soils.'

Eragrostiella bifaria (Vahl.) Bor in Ind. Forester 66:207, 1940 et in Fl. Assam 5:107, 1940. *Poa bifaria* Vahl., Sym. Bot. 2:19, 1791. *Eragrostis coromandeliana* Wight; Hk. f., Fl. Br. Ind. 7:325, 1897.

Previously known from Peninsular India.
Sundargarh, 800 ft., Gangpur State, Orissa, 28-7-1948, H. F. Mooney 3086 !'

NOTES ON THE SNAKES AND MAMMALS OF THE HIGH WAVY MOUNTAINS, MADURA DISTRICT, SOUTH INDIA

BY

ANGUS F. HUTTON

PART II—MAMMALS

(With one plate)

(Continued from p. 460 of this volume)

The area covered by this note is the same as that described at the commencement of part one, but includes, in addition, the Varushnaad Valley, which lies to the east of the High Wavy Mts. This valley, which runs north and south, is about 20 miles in length and 10 in width and is drained by the Vaigai river. The area from 1,800 ft. to 3,000 ft. is covered with thick deciduous forest with a dense undergrowth of *Lantana* and elephant grass. Above 3,000 ft. it merges into evergreen forest which runs up to over 6,000 ft. at the southern end. Except for a small area under paddy and cotton around Mylandamparai at the northern end, and some cardamom and coffee cultivation in the evergreen forest, the whole area is completely wild and uninhabited save for a few jungle people—Puliars—who lead a miserable existence, in this extremely malarious valley.

The rainfall is very light and mostly falls during the N.-E. Monsoon.

Though dealing with Mammals occurring in the High Wavy Mts. some of the observations were made in the Anamalai Hills of the same species in captivity.

My thanks are due to my friends who have allowed me to incorporate their observations into these notes and who have assisted me in every way.

Elephas maximus. Indian Elephant. (Tamil: *Yarnai,*)

Very common throughout the area, but visits the higher hills only during the dry weather. They have inherited roads along which they travel on their migrations. One road which is the main route between the Varushnaad Valley and Travancore is well over 20 ft. wide. Some elephants spend the whole year in this valley but the majority of them migrate to Travancore in June-July and return in December-January. The reason for this is that the grass burning in the Varushnaad starts in June, as it does not receive the South West Monsoon, but in Travancore (the Periyar Game Sanctuary area) the grass burning starts after the North East Monsoon is over, so really the elephants are driven back and forth. Some of the herds on their way back come up to the High Wavys, in November-December and remain there till May-June. They do a great deal of damage in the cinchona clearings, and to a far lesser extent to the tea. They are particularly attracted by tea and cinchona nurseries, and just walk over the beds, leaving desolation in their wake; presumably they like the soft earth underfoot. Several times they have passed close to buildings, but have never attempted to damage them. Some years ago a young one was born within 100 yards of some cooly lines. The dam's 'attendant' was a ¾ grown one—possibly its previous youngster. The whole family passed in full view of the coolies on the day after the birth. The herds in the hills rarely

exceeded twenty animals. When they are out feeding, either in the clearings or in the grassland the old bulls generally stop in the jungle or very close to them. One herd was being watched when an aeroplane flew over, and the reaction was instantaneous; all the elephants formed a circle facing outwards with the youngsters in the centre, until the danger had passed, and then they bolted for the jungle.

They were regular visitors to a large water hole near one of the bungalows though generally during night. Many years ago a lot of elephant trapping used to be done up here, by whom no one seems to know; there are chains of disused pits across all the main elephant paths and the present paths weave in out among them. Last year one elephant slipped and fell into a pit some 10 feet deep and later escaped; the other elephants had pushed in small trees apparently to help it to do so. The remains of two dead elephants were found, one in the High Wavys, and one in the Varushnaad. The former only consisted of one thigh bone and the lower jaw, and the latter was a fairly recent death—a cow—which I was told by some Puliars had been in a weak condition for some days.

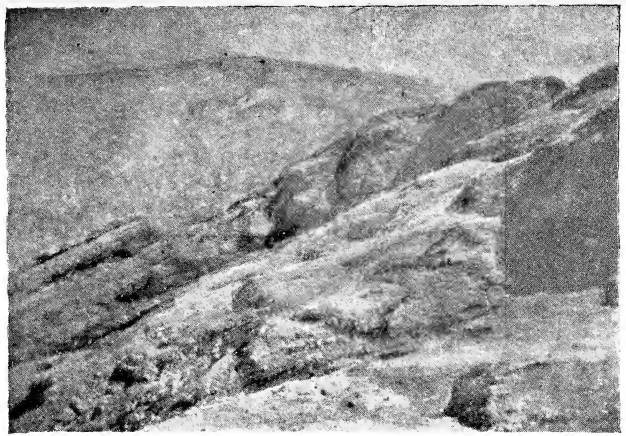
In 1937 an elephant was observed while actually giving birth to a calf in the Varushnaad. My informant tells me it was lying on its back. One curious habit of elephants which I have not seen recorded anywhere is that of sliding down a steep bank just for the fun of it. I personally have only seen one young bull repeat this sliding twice but other observers have seen a whole herd doing it. I know of several 'slides' or chutes where they amuse themselves in this way and all of them end in water. Sometimes, when in a bad mood they give vent to their anger by pushing down trees and thrusting at them with their tusks, I have seen quite big areas of jungle cleared of small trees in this manner, with the bigger trees scarred by their tusks.

Bos gaurus. Indian Gaur or Bison. (Tamil: *Kartu Madu.*)

A few herds live in the hills wandering from one grazing ground to another. In the Varushnaad there are far larger herds, but nowhere are they common. The great rinderpest epidemic some years ago, seems to have reduced their numbers badly in this area. Very few good heads are to be seen. The bison follow the same migration paths as the elephants, though I do not think they travel in company. Occasionally they visit the tea, but do no damage and keep pretty much to themselves. One parti-coloured animal was seen in 1946, but has not been seen since. Perhaps it had been wallowing in the white clay which occurs in patches up here, which had dried on its coat giving it the parti-coloured appearance? It was watched at 200 yards. Several remains of bison have been found, including two which had undoubtedly been killed by tiger.

Hemitragus hylocrius. Nilgiri Tahr. (Tamil: *Varri Ardu.*)

This animal though very common, is entirely confined to a few hill-tops, which afford it considerable safety from panthers. The biggest herd I have seen numbered well over 200 animals, including 9 'saddlebacks'. I once saw a duel between two males (described in Vol. 47, No. 2, p. 374). There does not seem to be any fixed breeding season, though I should say the majority of young ones are born about May-June. During the dry weather, when water on the precipitous slopes has all dried up and the grass is being burnt off, the tahr travels amazing distances, to fresh grounds in search of grazing and water. I have seen a complete herd in the centre of the Varushnaad valley, at about 2,000 ft. and well over 6 miles from the nearest hill, at this time. On another occasion I saw 7 sambar grazing in the middle of a herd of tahr, which took no notice of them at all. Wild dog sometimes succeed in cutting off a few from a herd and killing them. Three were seen in the evergreen forest about a couple of miles from their usual area, who must have been driven by wild dog. The heads in these hills are not very big and I doubt if there are many over 14 in. to be had, though there was one old warrior I tried to get, who had horns quite 16 in. or more in length; but he was too cunning for me. I have only once seen a tahr miss its footing on the steep hill-sides, and that was when I suddenly came upon a solitary one which in its efforts to escape jumped down on to a loose tuft of grass on a steep precipice. and fell a good 50 or more feet and regained its balance and made good



Two views of typical Ibex country in the High Wavy Mts. The valley below is the Varushnaad, and is some 3500′ lower than the point where the photo was taken. Herds of over 200 animals can be seen in this area.

Photos by

Evergreen forest with large rocky patches. A favourite haunt of tiger and sambar. Bison visit the grassy ridge on the right.

Author

Our Lion-tailed Monkey with its friend the Black Cat.

its escape though it was limping a bit. The tahr certainly seems to be maintaining its numbers well in this area, if not on the increase, and there is very little poaching done.

Axis axis. Spotted Deer. (Tamil: *Pulli Marn.*)

The Puliars and forest watchers tell me there are a few isolated herds in the extreme N.-E. of the Varushnaad valley, but as this place is a great distance from the estate, I was never able to visit it. I am told the heads are quite good, and have seen a few which were shot there. It is said to be maintaining its numbers, but some poaching goes on.

Rusa unicolor. Sambar. [Tamil: *Mila*; *Marn* or *Kombu Marn* (stag).]

A very common animal throughout the area but not where the jungle is too thick; it is commonest in the hills. They do a considerable amount of damage on the estate and are looked on as a pest. They strip the bark off Dadap (*Lithosperma* sp.) shade trees, and eat the leaves; are particularly fond of the bark of *Cupressus macrocarpa*, and kill hundreds of these trees annually in spite of protection given. They favour *Grevilleas* to rub their horns on to remove the velvet; they eat the tops of tea and cinchona plants and in fact are a thorough nuisance. Many are shot each year, others are caught in nooses set by the estate coolies, and wild dogs kill off several, but in spite of all this they are on the increase. Their breeding season is not clearly defined though most of the young are born at the start of the S.-W. Monsoon in May-June. It seems strange that 'Mother Nature' should arrange for so many of her young ones to be brought into a world of rain, wind and cold for the first 6 months of their lives and it is a wonder that such a large percentage survive. I once came upon a stag and a hind which were courting and eventually mated in my presence, and I obtained a few photographs of them, though unfortunately due to under-exposure unsuitable for reproduction here. This was in the month of March, and the stag had recently shed his horns; surely a curious state of affairs, as the horns are mainly intended for display or defence at this period. They were probably very late breeders. Stags are rarely out of velvet here till September-October. The heads in this area are very small, anything over 24 in. being unusual. The biggest head I have seen from these hills was just over 30 in. In the Varushnaad they run bigger and have a better spread. This must be due to the more open country, compared to the thick jungle of the hills. Once a young sambar was found almost dead in the tea by some pluckers. It had a big hole above its nose which was full of maggots. I put it out of its misery and a post mortem examination revealed a piece of 'eeta' (hill bamboo) which had entered above its nose and passed through the roof of its mouth and severed one eye as well. The poor creature must have suffered agonies, from its wound. Its parent was with it when it was found. Sambar, even when their young ones are being torn to pieces by wild dogs, will not desert them, sometimes at the cost of their own lives. With regard to the 'sore neck' which seems to be so common among these animals in other parts of India, I have only once seen a stag suffering from this complaint, out of several animals of both sexes which have been destroyed here. Much has been written about sambar 'stamping grounds' and I do not intend to add more; though I can say that there seem to be two sizes of these 'grounds'. The larger used for the purposes given by various writers, but the smaller 'grounds' I think are merely resting places, which the sambar keep clear of leaves, with their feet, the purpose, I take it, being to have a bed comparatively free of leeches. These smaller 'grounds' are generally placed to the leeward of trees and are used regularly. They usually have a well-scarred tree nearby where the stags remove the velvet from their horns, the same tree being used for years. Large quantities of ticks are always to be found in these places—several hundred getting onto one's legs in a few minutes if one stands nearby.

Muntiacus muntjac aureus. Barking Deer or Muntjac—Jungle Sheep. (Tam: *Kolai Ardu.*)

Not very common on the hills, though it is on the increase, Odd ones are occasionally seen in the early morning or late evening, when they come out of

the jungle to graze. A family party of three was seen some years ago, and I have seen pairs during the months of March-May, when the young are born. They are usually the first of the jungle folk, excepting monkeys, to give a warning of the presence of tiger or panther. A few are accidentally caught in traps set for porcupine by the estate coolies, each year. They make charming pets and become very tame, and are quite easy to rear if fed on 2 oz. fresh milk mixed with 2 oz. hot water, given 4 times a day. They start eating weeds and grass when about 6 weeks old. In the Anamalais we had a couple of bucks for over two years, and we found out something about the habits of these animals. We kept them on the old tennis court with a variety of other pets, including rabbits, sheep, chickens and ducks. One day we found the two jungle sheep eating a litter of baby rabbits which had fallen out of a hutch. On another occasion they had a young chicken and they have also eaten eggs. They make a queer sound sometimes by grating their teeth together. In the evenings the two had sham battles together and chased each other around, cracking their heads together, and so on, for an hour or more at a time. Once while racing round they both jumped over two chicken-run-frames in one bound. I measured it afterwards and the distance was 10 feet and 1½ feet high, and the jungle sheep cleared it with over a foot to spare. They are mainly nocturnal in their habits.

Tragulus meminna. Mouse Deer or Chevrotain. (Tamil: *Kuram Panni* or *Sarakumarn.*)

Though rarely seen, this little animal is fairly common and their minute tracks can often be seen on the sand at the side of streams. They seem to be very fond of water and most of those I have seen have been lying up close to a stream or water hole. They are very delicate and rather difficult to rear in captivity. A pair was caught up here some years ago and was later sent to the London Zoo where they lived for over an year. Occasionally coolies catch them in traps though this is discouraged. Comparing skins of these animals taken at different times of the year, it appears that they get considerably darker during the monsoon months and the hair also is thicker then. Being nocturnal in habits they are almost blind during the day and have to rely upon their highly developed hearing to detect their enemies. The lowest elevation I have seen a mouse deer is 2,800 feet close to some evergreen forest. They seem to be immune to the attacks of leeches; the peculiar smell that is left on one's hands after stroking them may be some secretion that helps in this respect. This same smell can be detected on jungle sheep who also seem to be immune. Some investigations in this direction would be rather interesting. They have a great liking for beans and these are often found half eaten in the garden.

Sus cristatus. Wild Pig. (Tamil: *Kartu Panni.*)

Another destructive animal, though mostly to private gardens. In the tea they dig up vast quantities of *Oxalis* bulbs, and if these happen to be growing amongst young tea or cinchona plants, the latter get dug up as well. To plant sweet potatoes or tapioca in a garden is merely inviting the pig to do his worst. They are also attracted by carrion, and I have on many occasions known pig to dig as much as 4 feet down in order to feed upon the buried corpse of some animal. They have been known to exhume and eat human bodies. They are the most cunning animals I know as regards the destroying of them. If one waits for them at one garden they will visit another and *vice-versa*. If a pit is dug, no matter how carefully covered, they will detect it and force a fresh entry into some other part of the garden. Place a few bombs amongst the potatoes and they will avoid them; only rarely does one get killed by this method. Occasionally they can be seen while lying up in wallows. If come upon suddenly an old boar, I find, is rather inclined to charge. However, they invariably give a warning of their intentions by standing in one place and rocking from side to side for a few seconds. This is generally long enough to enable one to get up the nearest tree! They are commonest in the hills though I have seen their tracks in the Varushnaad valley. The locals, though aware of their carrion eating habits, relish the flesh.

Panthera tigris. Tiger. (Tamil: *Puli* or *Kaduva.*)

Only a visitor to the hills during the dry weather, though it is possible a few remain all the year round. Their tracks are frequently seen on all the main game paths, especially those that lead to water holes, where no doubt it is easy for them to secure a meal. An account of a tigress shot up here in 1947 is given in Vol. 47, No. 1. They favour evergreen forest containing patches of open rocky grassland. One tiger which had been seen many times was almost white in colour, and was believed to be very old. A pair of cubs were taken from a cave at the foot of the hills in 1947 and are now in the Madras Zoo. A cub was seen in July 1947 and the tracks of a tigress and one small cub were seen in February 1948. A tree that a tiger had used for sharpening his claws was found and the highest scratch marks, (measured with my rifle) were 13 feet from the ground. The so called 'pooking' call of tigers is frequently heard and often it is answered by sambar. The only difference I can find between the sounds made by tiger and sambar is that the former is more 'throaty'. Some 15 years ago a coolie was killed by a tiger but was not eaten, so it cannot be called a man-eater. There was, I believe, a man-eater in the Varushnaad valley a year or two ago which accounted for several Puliars, but it was said to have been poisoned by them with some roots or other plant poisons. The flesh is used by the locals as a 'cure-all', and even the bones are ground up and used. The teeth, claws and whiskers are looked upon as the most valuable parts. In May 1948, coolies saw a pair fighting near the estate, tracks seen afterwards confirmed this.

Panthera pardus. Panther or Leopard. [Tamil: *Sirupuli, Peria Narri,* or *Karu Puli* (Black Panther).]

The Black Panther is far commoner in these hills than the normal spotted ones, though they are not found outside the evergreen forest area. The spotted ones are also darker than usual in this area. Their habits and movements are similar to those of the tiger, though I think they are definitely resident since panther kills can be found throughout the year, whereas tiger kills can only be found during the dry weather. They are extremely common in the Varushnaad valley where they follow the large herds of cattle that graze there in the early part of the monsoon, before the grass is burnt off. The cattle keepers tell me that there are one or two cows killed each night and sometimes more. No one goes there to shoot them as the malaria is so bad that it would be asking for trouble to do so. A black panther with two black cubs killed a cow and two calves in one night in September 1946 and a small portion of each was eaten. They did not return to the kills though they were seen by a watcher a few days later. Some years ago a fine male black panther was shot out in the open while it was watching a herd of Ibex. It measured 7 ft. 6 in. between pegs. Last year another large panther which measured 8 ft. 6 in. was shot. In May last year a spotted panther with two spotted cubs was seen on the road one night. I once saw a black panther lying asleep in a tree, some 20 feet up. I thought it was a monkey and it wasn't till I was quite close that I saw it was a black panther but unfortunately it recognised me as a human being at the same moment and with one bound was gone. The flesh is used for the same purposes as that of tigers.

Felis viverrina. Large Tiger-Cat or Fishing Cat. (Tamil: *Vanga Narri.*)

A rather rare animal and even more rarely seen. My only record is of two kittens which had been born in the tea, near a tree-stump which had a small hollow beneath it. They were found by some weeding coolies who were attracted to the spot by the sound made by the parent leaving the nest. The description of it given by the coolies, tallies with that of the tiger-cat. The two kittens were kept for some time by one of our staff who only informed me when they were getting weak. A friend took them on but neither survived long. They were rather docile little creatures and very prettily marked; neither had their eyes open when found, though they opened before they died. In the Anamalai Hills we had a visit by one which during 5 days took the following nourishment:—One goose; next night, 2 ducks; followed by 3 ducks; then a pair of rabbits; then 7 young rabbits! It was caught in a trap but escaped

leaving just enough fur etc., behind to identify it. It had torn out the wire netting of the trap.

Prionailurus bengalensis. Leopard Cat. (Tamil: *Puli Poonai.*)

This beautiful animal, though not very common, is frequently seen at night or in the evening due to its habit of sitting on tree stumps in the tea, whence no doubt it can spy for rats and other small game. I shot three while they were thus engaged. Another was shot by a friend when it was a good distance up in a tree. I wonder if they manage to kill roosting birds and squirrels! I saw a good many more than I shot including a $\frac{3}{4}$ grown young one in March 1948. They occur throughout the evergreen forest and I have seen one in the rocky grassland at about 3,500 ft. There seem to be two varieties of this cat: one has orange rosettes bordered by black, similar to those of the panther, and the other has plain black spots with a darker ground coloration. The latter is the commoner animal, in fact in these hills I have only seen two with rosettes. Measurements were: head and body 18 in.; tail 11 in. (maximum size). I did not weigh any of mine but they would be about 8 to 12 pounds.

Felis chaus. Common Jungle Cat. (Tamil: *Kartu Poonai.*)

This cat is not common in the hill jungle where I personally have never seen one, though it seems plentiful at the lower elevations. I saw several in the deciduous forest area, where it preys upon hares and other game. One large male I wounded attacked me, but I managed to kick it away from me and killed it with a second shot as it attacked again. My first bullet had passed through its chest and stomach and the second found its neck. It was met on the road late one evening. I am told by locals that it kills and eats otters but I would not have thought it would be bold enough to do so, as the otter is no mean adversary.

Moschothera civettina. Large Malabar Civet. (Tamil: *Punagu Poonai.*)

A fairly common animal in the evergreen forest, though not often seen. Their droppings are frequently found on paths in the tea. Dogs for some unknown reason love to roll in them, and in those of otters and mongooses. They smell simply awful after this, and it takes a good few days for the smell to go. The coolies occasionally catch them in traps and keep them alive. They collect the civetine which the animal exudes, and they sell it for ten rupees a tola. Though mainly fruit eaters they will eat meat when it comes their way, even carrion. The young are born in April, the nest being placed under a rock or stump. They are difficult to rear. I tried several times, without success.

Viverricula indica. Small Indian Civet. (Tamil: *Punagu Poonai.*)

I have only seen one in the deciduous forest at about 3,000 ft., though it must be fairly common, from the number of droppings seen on the roads.

Paradoxurus jerdoni. Brown Palm Civet. (Tamil: *Maran Nai.*)

Not very common in these hills, though its queer cry can occasionally be heard in May, which I presume is the breeding season. Their colour is extremely variable; I have shot one which was a pale buff, all over, with a slightly darker tail, and another was dark brown all over, and another light brown with the last 5 inches of its tail yellow. The two females I shot were both more ginger in colour underneath. One contained two almost fully developed young ones. They feed mainly on jungle fruits though I have no doubt they will kill small birds and mammals if they get a chance. One was found dead in a tea bush where it had strangled itself in a forked branch. I am told they become very tame in captivity though I have never kept one myself.[1]

Herpestes smithii. Long-tailed Mongoose. (Tamil: *Keeri Pilli.*)

A pair were seen once, in the early morning, on a road in the deciduous forest. They were digging furiously for something, I do not know what, but

[1] At the time of writing this, I have a youngster in captivity which shows signs of doing well. It was caught when half-grown and is very tame.

perhaps some insect, as the drain at the side of the road was a mass of little pits which had been dug by these two animals. I have seen tracks of mongoose in the Varushnaad valley, but I am not sure of what species. It is possible they were of the common Indian mongoose (*Herpests edwardsii*) which is common in the plains.

Herpestes fuscus. Nilgiri Brown Mongoose. (Tamil: *Karupu Keeri.*)

The Tamil name means black mongoose and I think this is a more correct name than brown mongoose, as the animal, in these hills at any rate, is certainly more black than brown in colour. It is very common and frequently seen in the tea. Like the last species it digs little holes all over the forest and roadsides. I once saw one eating an earth snake (*Uropeltis* sp.), which it dropped on seeing me and bolted. This incident led me to believe that they dig for these snakes. In the Anamalais a nest was found inside a hollow fallen tree containing three young. The young are certainly reddish in colour with an extremely comical appearance as they have a scarlet nose and lips, which I suppose disappears as they get older. This species is a notorious fish stealer and does a lot of damage for which the otter gets the blame. I have proved this in these hills, where I had stocked a water hole with marral from the plains. Only mongoose tracks were visible when I found a half eaten fish on the edge of the water, so a trap was set and a mongoose was caught. The next night another was caught over the same fish. I do not know how they did it, but they had captured 7 fish, all over 2 lbs. in weight. The next species I am convinced is also a fisherman, though I have not actually observed it fishing. This mongoose swims well on occasions so perhaps one swims out and drives the fish shorewards while the other lies in wait? How they knew I had put fish in the hole mystifies me, as there were certainly no fish there before. They are also poultry thieves.

Herpestes vitticollis. Stripe-necked Mongoose. (Tamil: *Sewapu Keeri.*)

A common animal, often seen during the day lying out in the open on rocks. This mongoose seems to have a favourite rock in its domain where it defaecates; such a rock, in time becoming covered with droppings. They are fond of water and one pair lives in a water hole near here. From my observation platform, they could be seen almost any time of the day slowly progressing round the edges catching frogs, etc., as they went. Their nest was among the roots of a large tree near the water's edge.

Martes flavigula. Southern Marten. (Tamil: *Kuran* or *Maran Poonai.*)

Three pairs were seen in these hills and it also occurs in the hills to the south of the Varushnaad valley. It is not often seen and is very shy and retiring in its habits. Some years ago a young one was caught by a dog, when it was feeding on the ground. They are quite fast runners when on the ground and spend a lot of their time there. I once saw one eating a Malabar squirrel it had killed, this incident is described elsewhere in the *Journal* (48:355).

Amblyonyx cinera. Clawless Otter. (Tamil: *Neer Nai.*)

A very common animal in most of our hill streams, though being mainly nocturnal in habits, it is rarely seen. Their droppings are often seen on the rocks. When suddenly disturbed they make a queer sound like a croaking *hoo-hoo* before diving beneath the surface and escaping.

Lutra vulgaris. Common Otter. (Tamil: *Neer Nai* or *Meen Nai.*)

A large male used to live in the water hole mentioned before. He could be seen any time of the day diving in the water and doing other antics. He was never seen to catch a fish though there were several there which he could have caught. He seemed to be after something else, though we never found out what it was. Possibly water snails or frogs. In the Suruli river early one morning a party of seven otters were seen swimming. I did not see them myself so I am unable to say whether it was one family or not. A young one was caught in January 1947 when it was roaming near the coolie lines, but it bit anyone who attempted to touch it and had to be released.

The perfect skeleton of one was found beside a path in the jungle. On being examined it was found that at some time in its life it had broken one humerus which had subsequently healed. The pair are now in the Society's museum. This otter often strays a considerable distance from water in search of food and its tracks are to be found on most game paths for some distance from water. They are fairly common in these hills, though, I am not sure of their lowest altitude.

Melursus ursinus. Sloth Bear. (Tamil: *Karadi.*)

A very common animal in this area. It is commonest in the deciduous forest and in the open grassland where wild dates abound. It has been met in the evergreen forest at over 5,500 ft. One was put up in the tea by some coolies in January 1947. The pits they make when grubbing for roots, etc., are often seen on the forest paths especially on those near open grassland. They have been seen many times out in the open during the day. On these occasions they never keep still a moment and behave exactly as if they had been stung by a bee. I met one in September 1947 quite close to where a herd of tahr or ibex was grazing. It saw me when I was a good 400 yds. away and bolted straight up an almost vertical precipice and was soon out of sight. Up till then, I had always imagined they had rather poor eyesight, in this instance it could not have winded me, as I was approaching up wind, and not making a sound either. I have never seen a young one though some tracks were seen in the Varushnaad valley in September 1947. During the time a road was being constructed, bears often paid a visit to the labourers' camps though they never harmed anyone. They seem to be nocturnal as well as diurnal in their habits.

Cuon alpinus Wild Dog. (Tamil: *Chen-Nai.*)

Fairly large packs roam the hills, and kill pretty well anything that comes their way. I do not think they are resident in the Varushnaad though the Puliars say a few sambar are killed annually by them, mostly during the North-East Monsoon. They are scarce in the hills at this time, so perhaps they find our N.-E. too wet, and seek their food elsewhere. I have twice met packs of them on the road at night and feel sure they were hunting sambar as later, alarm calls were repeatedly heard from the direction in which a sambar had gone. Our three dogs (a Labrador, a Silky Sydney and a Nepal Terrier) have twice met them in the jungle and no more notice was taken of them than a village pi would do. After a few minutes of sniffing around they went on their way leaving no ill-feeling behind. Many times they have killed sambar in front of working coolies in the middle of the morning, the coolies commandeering the meat. Once a young stag nearly knocked me over on a road near the lines, the dogs chased it past them and killed it a little further on in the river. Most of their kills were in water. In the Anamalais in 1945 a sambar stag tried to get into the dining room of our bungalow at about 8 p.m. one night when it was being chased by wild dogs. It broke the window frame and most of the glass and then rushed along the veranda and broke several flower pots. The following morning it was again chased through the garden into the tea beyond. We never knew the result of the chase though it was pretty obvious the dogs were tiring the unfortunate beast out. The pups are born in November-December, after the N.E. Monsoon is over. Only on one occasion up here have I known of the dogs attempting to attack a human being and that was when one of our staff, when alone, inadvertently passed near a kill in the tea and some of the dogs came out on the road and showed a very menacing attitude towards him and so he wisely beat a retreat.

Canis aureus. Jackal. (Tamil: *Kolon Narri.*)

Very common in the plains at the foot of the hills. I have never seen one above 2,500 ft. According to the Puliars there are none in the Varushnaad valley and I should think this is correct. The undergrowth there is very thick for jackals and the lack of human habitations too, would probably account for their absence. I have never seen a so-called 'Horn' known locally as 'Narri-Kombu', and which is supposed to have all sorts of wonderful magical properties. In the Anamalais a litter of three pups was found in a

hole in the ground in the tea fields at an elevation of 3,600 ft. The pups were kept in captivity for a time and later had to be destroyed under Medical Officer's orders for fear of rabies.

Vulpes bengalensis. Indian Fox. (Tamil: *Narri.*)

A very common little animal in the plains and the foothills and also I am told there are a few in the Varushnaad valley. It is said by the locals that they will exhume and feed on human bodies, though I have no evidence to show that this is true, beyond the fact that I once saw a couple feeding on a five-day old panther kill which was about 50% maggots. I shot one on the road-side one night whilst it was busy eating a hare it had just caught. The coolie who was with me at the time would not eat the hare as he said it would be poisoned by the fox having eaten it. The same coolie on the other hand was only too pleased to feed off the remains of a wild dog's kill.

Semnopithecus entellus. Grey Langur. (Tamil: *Vella Manthi.*)

A few troops here and there can be seen among the foothills, especially those that are rocky. I have never seen any in the Varushnaad though there is no reason why they should not live there. In one locality in the High Wavys there is a type of monkey that I have seen nowhere else, though a friend has seen it in the northern end of the Anamalai Hills. It may possibly be a relation of this species as it has much the same habits. It is much smaller than this species, being about the size of a lion-tailed monkey. Its outstanding difference lies in its colour which is grey with a black nape and white underparts. It makes a noise that I can only describe as being similar to that made by a lost baby chicken—a sort of plaintive *cheep-cheep.* I saw this troop (of twenty odd) twice at over 5,000 ft. but was unable to obtain any specimens. They are called 'Samba-Manthi' by the locals and the hill bears this name.

Macaca radiata. Bonnet Macaque. (Tamil: *Kurangu.*)

A very common monkey in the Varushnaad where large troops of over fifty animals can be found. They are often seen out on the ground, where they search for insects and caterpillars. Only once have I come across them in the higher evergreen forests and that was when a troop of some twenty animals visited the jungle in front of our bungalow at about 5,000 ft. in March 1947. They did not remain long and were speeded on their way by the Nilgiri langurs. In the Anamalais we had one for a few years as a pet, but it got very dangerous and had to be shot. It was found on the road-side almost dead, when perhaps two weeks old, and was fed on diluted milk and mashed banana. In its young days it was a delightful pet but as soon as it developed canine teeth it became nasty and was especially malicious towards women, and invariably sought them out when it escaped.

Kasi johnii. Nilgiri Langur. (Tamil: *Karu-Manthi.*)

Though it is very common in certain areas, it is comparatively rare in others. I do not think they care much for the cold and damp of our monsoons, especially the wind, and so seldom venture to the tops of the higher ridges even during the dry weather. But large troops can always be seen, in the more sheltered valleys. They visit the higher parts of the Varushnaad valley at certain times of the year, but never venture far from their home ground. They have a very definite sense of territory and with a little observation one can tell the exact place they are likely to be found, on a particular day of the week, as they have certain feeding grounds which they visit regularly. In front of our bungalow they used to come and feed on the Morning Glory creeper which grew there, the flowers being the choice part. In the evenings they often descended to the ground and foraged for fallen fruits and insects, etc. If disturbed when they are some way from the jungle it is very amusing to see the way they attempt to run. They leap into the air and progress with a series of galloping jumps and bounds, and can travel quite fast, though they are occasionally caught by coolies on the run. The method employed is to catch them by the tail, swing them in the air and beat their heads on the

ground. The flesh is highly esteemed by the locals as a cure for all sorts of lung complaints. The liver is said to be the best part. Some folk say that the whole monkey should be boiled in brandy, and the liquor thus obtained bottled, and used as required. An adult monkey weighs about 25-35 lb. The young are mostly born in June, though a few are born throughout the year. The females at this time keep to themselves and the males leave the main troop, returning after the young are born. I have kept several at different times; they do not do well in captivity, are difficult to feed, and are liable to turn nasty.

Macaca silenus. Lion-tailed Monkey. [*Tamil*: *Singilli Manthi*, *Singalam Manthi*, or (some places) *Arakkan.*]

Comparatively rare in these hills. More are found in the hills to the south of the Varushnaad valley. They are very shy in their habits and live in the thickest of jungles. Once used to the sight of man, they have no fear, and will allow a close approach. There is one old solitary male who lives in a patch of jungle through which our outlet bridle path passes. He loves to sit in a tree just over the road and waits quietly till you have passed by underneath and then makes a loud *Hoo*, noise, not unlike a tiger's 'cough' and if you are not prepared for it, you jump! I have never seen a Black Monkey (Nilgiri Langur) in the territory of this species. They move about almost effortlessly in the trees and never jump from one tree to another unless disturbed; they much prefer to reach out and slowly walk into the next tree or else they descend to the ground and climb up. The locals will not eat the flesh of this monkey as they hold it sacred, and also believe that it brings good luck. Young ones are often caught and kept in captivity by shopkeepers, presumably to promote business. They make excellent pets and never attempt to bite unless teased, and are very clean in their habits. In the Anamalais we had one (a female) for 8 years. It is still living with its present owner, being now nearly 10 years old. It was on the best of terms with a black cat we had (see photo) and on more than one occasion we have seen the monkey trying to suckle the cat. She used to hold it in her arms like a baby. Once we saw her doing the same with a dead rat she had got hold of. She used to make a variety of sounds of which we soon got to know the meaning. She had sounds for anger, hunger, sorrow and joy; and another sound she only made when she was 'on heat'. On these occasions she used to be rather irritable and off her food. Once we rescued a white cat she nearly killed by strangling, though not without some difficulty. In the Anamalais there are almost as many Lion-tailed as Black monkeys and so some trespassing on each others' territory is inevitable. On these occasions some terrific battles take place in the trees, and there are casualties on both sides. They make a row that can be heard for a great distance and some of the monkey oaths, used, I should imagine if translated into English would be quite unprintable! The Lion-tail is fond of water and has been seen bathing in a river and is said to be quite a good swimmer, though I have never seen them swim in the wild state. Our pet fell in the water tank once and used a sort of crawl to reach the side. There seem to be two sorts of Lion-tails; a very large one that is found in the Wynaad and in the High Wavys, and a smaller type that is found in the Anamalais. The former weigh 25-30 lb. and the latter 15-20 lb. only. Possibly it is something to do with surroundings that affects their growth.

Loris tardigradus. Slender Loris. (Tamil: *Thevangu.*)

A rather rare little animal, and difficult to find. I saw two in one tree one night at about 2,000 ft. In the Varushnaad the Puliars say it is fairly common, though I have never seen one there. I do not know anything about its habits, though apparently it is confined to the deciduous forest, up to about 2,500 ft.

Manis pentadactyla. Indian Pangolin. (Tamil: *Arrakannu*, *Arangu* or *Alangu.*)

I have never seen one in its wild state, though it does occur in these hills. One was seen by some coolies in the evergreen forest about two miles from the estate, at about 4,600 ft. Another was killed by some dogs on a cardamom

estate at the southern end of the Varushnaad valley at about 3,500 ft. It seems to be very rare and I think must be nocturnal. I have once seen the queer tracks left by its fore feet and tail which must drag on the ground as it walks. The scales are prized by the locals who use them as charms to keep off evil spirits! I know of two having been kept in captivity by planters in other districts and they are said to become very tame though rather delicate.

Hystrix leucura. Porcupine. (Tamil: *Mullampuni.*)

A very common animal throughout our hills. I am not sure whether it is found in the Varushnaad or not. I have seen its quills at 3,000 ft. but not lower. It does a great deal of damage in the tea and to a lesser extent to other crops. During the dry weather they take up residence in the jungle boundaries of the estate and at night carry out raids on the tea. They dig towards the main tap root and gnaw through it, resulting in the death of the bush and then pass on to the next. Large numbers are trapped with wire nooses at this time, which are set on their 'runs'. They are very easy animals to kill; a slight tap on the end of the nose kills them instantaneously. One attacked a dog which ventured near it when it was caught in a trap by its foot; the dog collected a lot of quills in its body. Tigers for some unknown reason like to eat porcupines and one used to eat trapped ones regularly. They are very good eating. The quills are used by the coolies as pins to fasten up the 'cumblies' (blankets) that they wear during the wet weather.

Lepus nigricollis. Black-naped Hare. (Tamil: *Musal* or *Moyal.*)

Quite common in the plains and in the grassland right up to over 5,000 ft. They are often seen on the roads at night, and also in the paddy fields. I have seen several in the Varushnaad, even in quite thick deciduous forest. They are much preyed upon by foxes and wild cats. I do not think they are very good eating, and they are scavengers of the worst type. Large numbers always lived close to the camps when we were constructing a road to our estates.

Ratufa maxima. Malabar Squirrel. (Tamil: *Mallai Anil* or *Kartu Anil.*)

A very common animal throughout the evergreen forests. It is not found in the deciduous forest or in the Varushnaad valley. Their alarm calls can always be heard during the day and they give one of the first warnings for the felines. They often use the same nests for some years running, keeping them repaired and adding to them each year. I have examined several nests in trees which we felled (during some clearing operations), though many of them were damaged by the fall. Their average size was 2 ft. in diameter and the inside looked as if it would hardly accommodate an adult squirrel, being barely a foot across. They bring forth two lots of young each year, as far as I can make out: one lot in September and another lot in March, the average per litter being two. Once only have I seen three. The young remain with their parents for six months or more and then go off on their own. The adults, I think, pair for life, though they have no sense of territory as the monkeys have. When the young are past the milk-diet stage, both the parents help in the feeding. Quite often I have seen these squirrels foraging together: one on the ground collecting nuts, etc. which the one in the tree knocks down. Very occasionally one comes across a squirrel larder at the base of some tree, which may contain upwards of two measures of nuts and other hard fruit. There are two types of Malabar squirrel in the High Wavys: one has a broad black band round the shoulders, and the other has a narrow band placed further back so that the shoulders are chestnut red. The former is the more common and it is the larger of the two; its tail also is more bushy. They make excellent pets if taken fairly young, at least past the milk stage. I have kept two; the second one I had for 6 months but it died from over feeding when I was home on leave, four months later. It was fully grown. It was very clean in its habits and could always be seen cleaning its fur, taking special care over its tail which was carefully combed out from the base with its fore feet, while it sat upright. It often used to lose its balance during this process, though it always immediately regained it. It had a varied

appetite, and could put away an enormous quantity of food at a meal. It loved bananas, grapes, oranges and mangoes; it also used to eat cabbage leaves, Morning Glory, roses, carrots and peas. It would not touch groundnuts or beans. It liked tea to drink and often drank water. It did not, or could not, ever make the adult sounds, though it often squeaked. I once saw an adult being eaten by a Tree Marten (described in the *Journal*, 48:355).

Funambulus palmarum. Palm Squirrel. (Tamil: *Anil.*)

Very common in the plains and in the Varushnaad valley. It is very fond of rocky country and it makes its nests in among the rocks. They are often seen on the ground or on the parapet walls of the road to the estate. It does not ascend the hills above 4,000 ft. and does not frequent evergreen forests.

Funambulus sublineatus. Dusky Squirrel. (Tamil: *Anil.*)

It does not like thick forests much and so not often seen in our jungles. It is quite common in the Varushnaad, and in light evergreen forest. It prefers country that has a light rainfall and fairly sheltered. In the forests at the south of the Varushnaad, however, it is quite common up to 5,000 ft.

Funambulus layardi. Jungle Striped Squirrel. (Tamil: *Samba Anil.*)

A very common little animal, found throughout the hills above 3,000 ft. It is very shy in its habits and extremely difficult to approach closely. I have only seen one nest, and that was wedged between some creepers and the side of a tree, some 15 feet from the ground. It was made out of leaves and sticks and was roughly spherical in shape and about 9 in. diameter. It was still being built when I saw it in April, so I presume the young would be born the following month. They often forage on the ground for insects, and climb up the nearest tree with amazing rapidity if disturbed. Hawks are their chief enemies and they will start a terrific bird-like chatter, which is taken up by all the squirrels in the area as a warning cry, when a hawk is in the neighbourhood.

Petaurista philippensis. Common Grey Flying Squirrel. (*Paruvakeerie* or *Paruva-anil.*)

Very common in the evergreen forest up to about 4,500 ft. It is commonest at 3,500 ft. and very rare above 4,500 ft. It does not live in deciduous forest though I have seen it on the borders. I should say they are the commonest of all the squirrels within the altitudinal limits mentioned. As many as twenty have been seen at the sides of a jungle road some 4 miles long. They are never seen during the day unless disturbed, but they come out before dark to feed. I have found the best time to observe them is between the hours of 7 p.m. and 10 p.m. with the aid of a powerful torch. Quite often large parties can be seen in one tree, if it happens to be fruiting. When gliding from the tree tops they can steer a course in and out of the trees with the aid of their tail which is flattened for the purpose. The maximum distance I have actually measured for one of these glides was just over 100 feet and was down a steep hill-side. They have no fixed breeding season and youngsters can be seen throughout the year though the majority are born in September and March. They vary in colour considerably though as they get older the silvery grey markings on the back get larger till in a mature specimen the back is this colour all over. During the monsoon the fur gets thicker and they lose it during the early part of the dry weather, some specimens having a very moth-eaten appearance at this period. An account of a nest and young one from the Anamalais was published in the *Journal* [46 (3)]. They feed as much upon insects as on fruits. Adults weigh from 6 to 8 lb.

Sciuropterus fuscicapillus. Small Travancore Flying Squirrel. (Tamil: *Paruva Poonai.*)

Occasionally seen in the evergreen forest but only in certain areas. It is not a common animal and prefers keeping to the highest of trees. I have seen them in company with *P.philippensis*, and they seem to get on well together. I have never seen a nest but presume it is similar to the last

species. The young I have only seen twice, in March, but whether it breeds at other times during the year or not I am unable to say. The adult male has a dark brown tail and the female a gingery-brown one, otherwise their colour is the same. I do not think they descend lower than 3,500 ft. in our hills. A friend has a young one in captivity in the Anamalai hills; it is very tame and not unlike the adult in colour. When disturbed in the daytime it growls like a dog. When at rest it carries its tail held over its head like a canopy. This gives it a very ferocious appearance. It is no doubt a method of protection. It started to build a nest out of sticks etc., when it was about 5 months old but soon gave up.

Bandicota malabarica. Bandicoot. (Tamil: *Perichyelli.*)

Quite a common animal throughout the area, specially near human habitation. They are often caught in traps by the coolies who love the meat; only the lower castes, however, eat it. They do a great deal of damage to buildings by tunneling in the walls and beneath floors.

Rattus rattus rufescens. Common House-Rat. (Tamil: *Veete yelli.*)

The commonest of our rats. It is a great nuisance on the estates and does much damage to stored grains. We once caught one in a box trap, which, in the morning was found to contain, not only the rat, but a family of 6 young ones that had been born during the night! We felt so sorry for it that it was released in the jungle with its babies, which it carried away later.

Rattus ratus wroughtoni. Common Indian Rat. (Tamil: *Maran yelli.*)

Quite common up to about 3,000 ft. in the deciduous forests. It is very common in the Varushnaad valley. They are often seen on the roads at night, where they search for scraps of grain that fall from passing carts and lorries, and are often run over.

Golunda ellioti. Indian Bush Rat. (Tamil; *Kartu Yelli.*)

This rat though very common, is confined entirely to the open grassland country from the plains up to over 6,000 ft. Its burrows in the grassland, which are close to the surface, are liable to fall in if trodden on, which can result in a sprained ankle, or a nasty fall. They have appeared in the tea area recently and are doing some damage in the same way as the porcupine.

Rattus blanfordi. White-tailed Wood Rat. (Tamil: *Maran yelli.*)

Occasionally caught in traps, but it is otherwise rarely seen. We caught some in the factory firewood shed. I do not think it is found outside the evergreen forest area.

Mus musculus. Common House Mouse. (Tamil: *Veete Sundyelli.*)

Quite a common little creature in the hills, where it is often caught in traps. I am not sure of its range, but believe it occurs in the Varushnaad. A nest with four young was once found in a sack of silk-cotton, in the bungalow. One of the young was inadvertently stuffed into a cushion with cotton, and was discovered some days later when it made its presence known!

[**Mus booduga.** Indian Field Mouse. (Tamil: Kartu Sundyelli.)

These have much the same habits and distribution as the last species, though the nesting habits are different. They generally make their nests underground, though I have found one above ground. This was a spherical ball of grass woven into some stems of lemon grass and was only about 6 in. in diameter and some 18 in. from the ground. I only had a momentary glimpse of the adult mouse, so cannot be quite certain of its identity, though being more white than grey beneath, feel that it must be this species, or possibly the next.]

Vandeluria oleracea. Long-tailed Tree Mouse. (Tamil: *Maran Sundyelli.*)

I have only caught one of this species in a trap. It does not seem to be common in these hills. I know nothing of its habits.

Paraechinus micropus. South Indian Hedgehog. (Tamil: *Mulluyelli.*)

I have never seen one in its wild state though I found the remains of one that had been run over by a lorry on the ghat road at about 2,000 ft. I know nothing about its habits save that it is nocturnal. The Puliars say it is common in the Varushnaad Valley, and that it is very good eating, if baked in its skin. I know porcupines are excellent cooked in this manner.

Suncus sp. Common Musk Shrew. (Tamil: *Moonjeuru.*)

Very common throughout the area. They are frequently caught in traps set for rats. They have a wide range and can be found up to over 5,600 ft. One was often seen collecting insects at the edge of a water hole in the jungle in daytime. I have never found a nest, and know nothing of its breeding habits, though I should think they would be similar to the next species. Dogs will have nothing to do with a shrew nor will cats. Apparently it gives off some smell that is very disagreeable to them, though not unbearable to humans. They are good swimmers.

Crocidura perrotteti. Indian Pigmy Shrew. (Tamil: *Sinna moonjeuru.*)

Rather rare in this area; I have taken three specimens—one of which was a female containing four young. I have never found a nest though I believe it is made in the ground, as I once saw an adult carrying a piece of straw into a burrow. The burrow was later dug out for some feet without success. Their extraordinary shaped ears and minute size—barely 2 in., including the tail—help to make their identification easy. They seem to be almost blind during the day, but as they are occasionally seen out at this time, I presume they rely upon their sense of smell.

Tupaia elliоti. Madras Tupia. (Tamil: *Anil*=Squirrel; the locals cannot tell the difference between the two and have no special name for this in their language.)

Quite a common little creature in the evergreen forest. They were often seen on logs and fallen trees during the daytime. If disturbed they immediately run beneath the log and travel some distance along the ground and then up the nearest tree. They prefer, however, bamboo forest and make their nests within the stems. They are generally seen in pairs. I have only seen one empty nest, which was discovered when a pair under observation, suddenly disappeared half-way up a bamboo, and later reappeared at the same place. The entrance was at the top of the section of bamboo, and seemed to be a natural hole, where a side shoot had broken off. The nest itself was just lined with leaves and grass. I was not able to revisit this place to find out more about them.

Pteropus giganteus. Flying-Fox. (Tamil: *Peria bavaal.*)

Fairly common on the plains and in the Varushnaad valley, where they are often caught while roosting by the Puliars who eat the flesh. I have never seen one above 2,500 ft.

Cynopterus sphinx. Short-nosed Fruit Bat. (Tamil: *Bavaal.*)

The commonest bat in the hills where it is often seen in the evenings, flitting about at the edge of the jungle, catching moths and other insects on the wing. [?—EDS.]

Scotophilus kuhli. Common Yellow Bat. (Tamil: Bavaal.)

Also very common in the hills as well as the plains. I have seen several during the day roosting in the roof of the bungalow. One was found in the curtains.

Kerivoula picta. Painted Bat. (Tamil: *Sewapu Bavaal.*)

On two occasions I have seen this bat outside my bungalow. Both times I thought it was an Atlas Moth (*Attacus atlas*), and went out to investigate. I have never seen one anywhere else. It seems to be rather rare in the hills.

(There are other bats in this area which I have not identified).

SOME NOTES ON THE BIRDS OF THE NEPAL VALLEY

BY

MRS. DESIREE PROUD

(With a sketch map and a plate)

The following notes were collected during a year's residence in the Nepal Valley, from February 1948 to February 1949. They are from sight records, but I have only noted birds of whose identity I am in no doubt. Others, seen indistinctly, such as crested drongos, various nightjars, hill partridges, etc., I have not included.

The birds are those of the Nepal Valley itself, and the hills immediately surrounding it. We have not been fortunate enough to visit any of the higher hills—those glorious ranges of perpetual snow, which dominate the northern scenery from Kathmandu.

The Nepal Valley lies, at an elevation of 4,500 ft., between the Mahabarat range and the main ranges of the Himalayas. In extent about 12 miles by 18, it is a comparatively flat depression set in the midst of a succession of mountain ranges. To the south-west it is bounded by the Chandragiri range, of an average height of 7,000 ft., but rising in its peaks to 8,000. Over this runs the path to India. To the south-east is Phulchok, a massive offshoot of the Mahabarat just over 9,000 ft. It is densely clothed with evergreen forest right down to Godavari at its foot, where the Maharajah has a park, and a number of houses seldom used nowadays. The bird life here is particularly rich and varied. Chandragiri is also covered with forest, but it has been much thinned by cutting.

The Sheopuri Lekh, of which the highest point is just under 9,000 ft., forms the valley's northern boundary. The lower slopes are under grass or cultivation up to some 6,500 ft. There are patches of scrub jungle, interspersed with cultivated fields, and Chir pine plantations. About 5,500 ft. is the T.B. Sanatorium, set on open slopes with wide views over the valley. The upper slopes are covered with forest, and abound with birds. The view from the top of Sheopuri must be amongst the most beautiful in the world, especially in winter, when all the country to the north is covered with snow. Last winter there was snow for weeks on the hills above 7,000 ft., but it very rarely falls in the valley, where the climate from October to March is almost perfect, cold but with brilliant sunshine almost every day.

Sheopuri falls rapidly in elevation to the east and west, and minor ridges run south to join with the Chandragiri and Phulchok and so complete the encirclement of the valley. To the west and highest point is Naga Jung, a conical forest-covered hill, just under 7,000 ft., and swarming with birds.

The valley is drained by the Bagmati and its tributaries. To the west the Vishnumati, in the centre the Bagmati, and to the east the Manora. All rise in the Sheopuri and first run south,

then the Manora and Bagmati turn west and are joined by the Vishnumati just before the combined stream turns south to flow out of the valley by the gorge of Chorbar, and then on through a tortuous passage between the Chandragiri and Phulchok. All three streams are wide and shallow. In the winter and hot weather mostly beds of damp sand, with a small stream in the centre, in the monsoon full to the banks, but only a few feet deep. Nepal is on the whole very poor in waders and water birds.

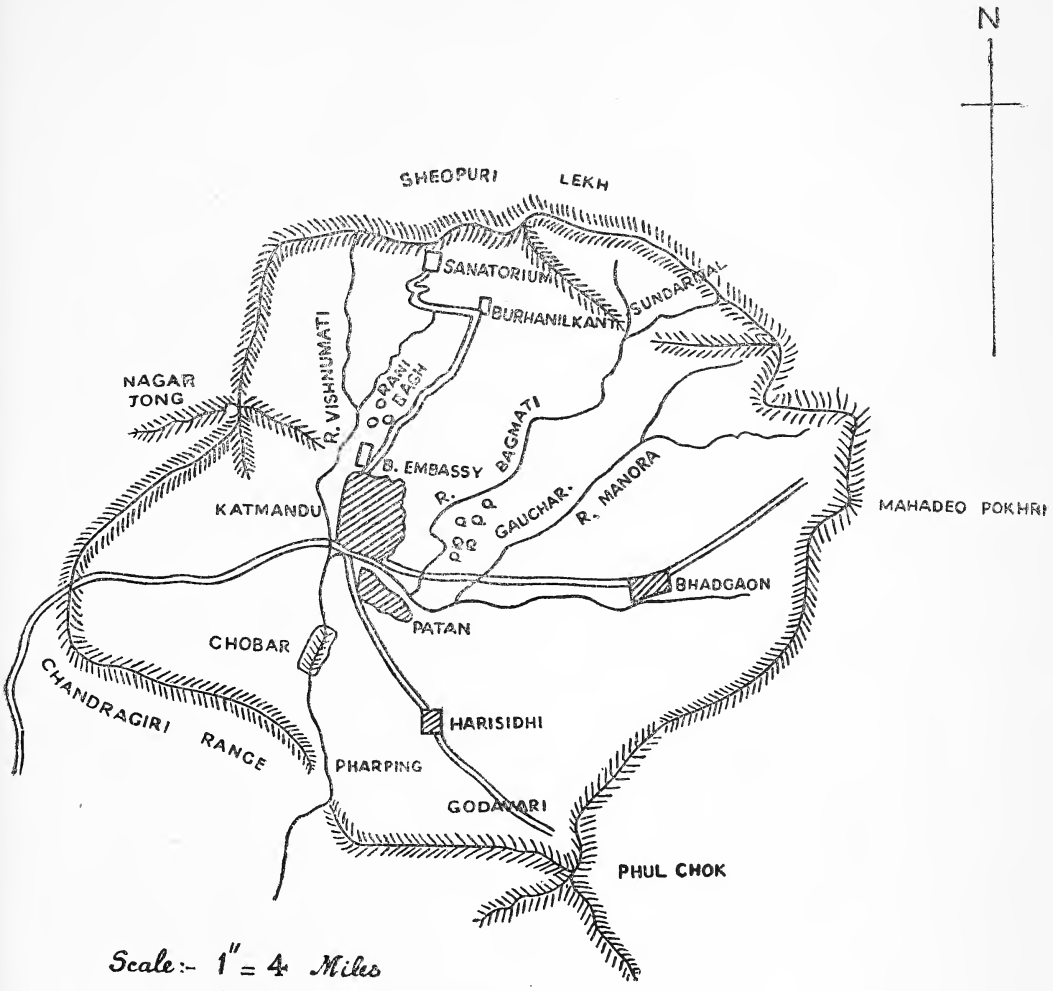
The bird life varies a good deal between the different hill ranges, according to the density of the forest. At Sandarigal on Sheopuri where the Bagmati flows out and down into the valley, a dam has been built to provide electricity, and this attracts many birds such as forktails, dippers, kingfishers and redstarts not seen elsewhere.

The oak forest starts at about 6,000 ft. with *Quercus incana*. At about 7,000 ft. this gives place to other species of oak. Rhododendrons abound also from about 6,500 ft. upwards. When in flower these are a beautiful sight—rose pink and pure white as well as the more common red. The scenery of these mountains is lovely beyond all words. We spend most Sundays out on the hills, and they are amongst the pleasantest days that I can ever remember. Unfortunately during the monsoons it is difficult to get out as our small car becomes bogged in the mud, and the forests swarm with leeches. Therefore, my notes for the months July—end September are confined to the birds of the valley itself, which are much less interesting, being mostly those already familiar in the plains of India. The breeding season is confined to the months April—end June. The heavy rains of July destroy most nests built too late.

There are three large towns, and numerous villages in the valley which is heavily cultivated, and provides little cover for birds. Wheat is grown in the winter, being sown end November and December and reaped in May. Broad-beans are also grown extensively in winter as well as potatoes and many other vegetables. As soon as the monsoon has set in the rice is planted, and this is the most important crop of the year. It is reaped from September to November.

Almost no animal labour is used. The ground is deep dug by hand, and really dug, not the mere surface scratching that one sees too often in India. I have seldom seen a more loved and well-tended land. When the rice is full grown the valley is at its most beautiful—a wonderful shining green, with the golden temple roofs enhancing the picture. Indian corn and koodoo are grown in summer on slopes too steep to be irrigated for rice.

There are few woods in the valley, but many gardens. An exception is the Rani Bagh—a dense wood surrounded by a boundary wall. It is quite close to the British Embassy and is a favourite site for those birds which breed in the valley. In the centre of the valley is Goucher, a grassy plateau, with woods on its northern and western flanks which run down to the beautiful golden temples of Pashpatti. Some of the paths through the valley are bordered by high hedges, but these are not frequented



NEPAL VALLEY

by the numbers of birds one finds in the hedges in England. They are however favourite haunts of the chiff-chaff, crested bunting and tree pipit in winter.

With the exception of white wagtails, ducks and teal, Nepal is disappointing as a migration route, and does not compare with Kashmir and Simla in the numbers and varieties of passage migrants. Many of the winter visitors arrive surprisingly late, as for instance the Kestrel which was not seen till November 11, later than it arrives in S. India. I wonder if these have migrated into India from the N.W. and then spread up into the Nepal hills from India. There are some surprising absentees. I have seen no grey tits, 'seven sisters', wren-warblers, or bee-eaters.

I have used Stuart Baker's Fauna of British India, and the list of birds in Landon's 'Nepal' compiled by Mr. S. H. Prater of the Bombay Natural History Society.

Corvus macrorhynchos: Himalayan Jungle Crow.

Found sparingly in pairs on all the hills surrounding the Nepal Valley. Scarce in valley itself. One pair nested in the Rani Bagh. It fed greedily on the small half-wild pears, and I watched it carrying these off to its nest. June 4th.

Corvus splendens: Common House Crow.

Abundant all over the valley. Not in hills. They roost in enormous parties in several groups of trees in the valley, one of these the wood near Harisidhi. In the evening huge flocks flying home remind one of rooks in England. Nest building commences early. One pair in our garden started building in a chestnut tree early March, but carried up only a stick or two per day, and completed nest about May 21st. Enormous numbers of nests in Harisidhi. Most birds sitting June 5th. One feeding young koels September 12th.

Urocissa melanocephala: Red-billed Blue Magpie.

Very common all the year in Nepal Valley, keeping to well wooded gardens and small woods. Also found in jungle hills but not much above 7,000 feet. In family parties February-March in our garden. These broke up into pairs end March, the young birds driven away with difficulty. March 25th a pair searching through our garden calling softly to each other. Mid April carrying nesting material. Nest found May 18th, slight platform of twigs, about 15 feet from the ground, placed on level branch in monkey-puzzle tree (*Araucaria*) near the trunk. No attempt at concealment. Five young. Both parents feed.

May 21st. Young growing fast, one sits on edge of nest, flapping wings continuously. Head and neck rusty black contrasting with white under parts and white nape patch. Bill black, not red like parents'.

May 23rd. All young on edge of nest flapping wings. By 10 a.m. four birds had left the nest and were sitting in surrounding branches. When parents bring food all young get very excited, one over-balanced and flopped down into bushes. Parents very agitated flew down to it. Saw one parent catch snake at least two feet long, and carry it off, but did not see it give it to young. Tails of young almost non-existent.

May 31st. Young still being fed by parents but can now fly fairly well. Tails several inches beyond body. Saw parents bring grasshopper three times, slug once. Scolds intruders furiously when they approach.

June 8th. Young magpies fly well now. They abandon our garden by day, which they appear to spend in the Rani Bagh. Every evening they return to roost in thick tree in our garden, arriving regularly about five o'clock. Every morning about nine they depart flying one after another, making a great clamour. Tails growing well extremely graduated. Bills still black, edged orange.

June 24th. Above routine still continues.

July 13th. Now only return to garden occasionally. They all came today and came right into the verandah hopping over tables and chairs calling softly to each other but bursting into loud clamour when they see a stranger. Young almost like parents now but much smaller and generally less spruce looking. Tails full grown; black parts rather dark brown than velvet black. Blue grey of back much duller. Nape patch very distinct, bill still black marked orange.

September 23rd. After two months' absence magpie family returned to garden. Young birds now indistinguishable from parents. Bills orange red. They still keep all seven together and all scold intruders.

November 7th. Seven magpies still together in garden most evenings.

February—ditto.

Dendrocitta formosae: Himalayan Tree Pie.

Common in the Nepal Valley in winter; keeps to well wooded gardens or woods like the Rani Bagh, where several always seen. Also common on the lower slopes of hills. Leaves valley to breed about the beginning of April, not seen after that below 6,000 feet. First seen in valley in autumn November 12th, but not common till November 19th, after which seen again in all the usual haunts. A pair generally in our garden.

Garrulus lanceolatus: Black-throated Jay.

Rather scarce but pairs seen occasionally on Sheopuri about 6,000 feet.

Garrulus bispecularis: Himalayan Jay.

Fairly common on all the forested hills above 6,000 feet.

Parus monticolus: Green-backed Tit.

Never in valley itself but fairly common on all the hills from 5,000 feet upwards. Does not move at all with the seasons.

Lophophanes ater: Himalayan Coal Tit.

Seen once only—December 21st—a little party about 6,000 feet on Nagar Jong in the evergreen forest, amongst a party of yellow-cheeked and red-headed tits.

Machlolophus spilonotus: Northern Black-spotted Yellow Tit.

Only one bird seen in our garden April.

Machlolophus xanthogenys: Northern Yellow-cheeked Tit.

Very common, both in Nepal Valley, and on all the hill-sides up to 8,000 feet at least. Most leave the valley itself about the end of April to breed on the hills. May 21st, a family party with three young in our garden. Family parties seen occasionally rest of summer. They do not become really common in the valley again until October. They are however, still found in the coldest weather up to 8,000 feet.

Aegithaliscus concinnus: Red-headed Tit.

Common on all the hills from 5,000 feet upwards. Always in flocks, April onwards, so evidently early breeders. Commonest at about 6,000 feet.

Sitta himalayensis: White-tailed Nuthatch.

Common on hills above 5,500 feet, not in valley itself.

Sitta castaneiventris: Cinnamon-bellied Nuthatch.

Very common in the valley itself and on the lower hills to about 6,500 feet. Feeding fledged young in June in the valley.

Dryonastes caerulatus: Grey-sided Laughing-Thrush.

Rather scarce. Did not see any till January 16th when I got a good view of a small party in bamboo scrub at 8,500 feet on Phulchok. Has a very

sweet whistle of three or four notes. I have since heard this on Chandragiri and Sheopuri so perhaps they are commoner than appears from sight records.

Garrulax pectoralis: Indian Black-gorgeted Laughing-Thrush.

Seen only once in June in scrub below the Sanatorium at about 5,500 feet in mixed party of tits, etc.

Garrulax moniliger. Indian Necklaced Laughing-Thrush.

Seen once only early June together with last species in scrub below Sanatorium.

Garrulax albogularis: White-throated Laughing-Thrush.

Very common in large flocks on all the jungle-covered hill-sides between 5,000 and 8,000 feet.

Trochalopteron erythrocephalum: Red-headed Laughing-Thrush.

Only seen on Sheopuri where it is common both in scrub below the jungle, and in the dense jungle itself right up to 9,000 feet. Always seen in flocks and very skulking.

Trochalopteron lineatum: Streaked Laughing-Thrush.

Not seen for certain in Nepal, but heard, we think, on Sheopuri hills about 8,000 feet.

Acanthoptila nipalensis: Spiny Babbler.

Seen occasionally creeping about in undergrowth in the vegetable garden, our garden, and hedgerows. Has loud call *chek* ..... *chek,* but skulks so much it is extremely difficult to see.

Pomatorhinus ruficollis: Nepal Rufous-necked Scimitar Babbler.

Moderately common on jungle-covered hill-sides; prefers thick scrub to tree forest. Very skulking, and more often heard than seen.

Pomatorhinus erythrogenys: Rusty-cheeked Scimitar Babbler.

The commonest scimitar babbler of the jungle hills round Nepal 4,500 to 7,000 feet very shy but their melodious calls constantly heard. Particularly common on Nagar Jong and the Sheopuri scrub jungle below the Sanatorium.

Stachyridopsis pyrrhops: Red-billed Babbler.

Common on jungle-covered hill-sides. Prefers true jungle to scrub. 4,500 to 8,000 feet. Commonest at Godavari but also on Nagar Jong and Sheopuri. The note described by Stuart Baker as like the 'ringing of a tiny bell' is a very exact description. It has also a churring scolding call.

Alcippe nepalensis: Nepal Babbler.

Very common in thick jungle especially Godavari and Sundarijal. I did not notice them much between June and October so they may have migrated to the higher hills to avoid the worst of the monsoon. Nest at Godavari April 4th half built, both parents building, bringing large quantities of white spiders' web to weave into foundation. Nest about two feet from ground; later destroyed by wood cutters.

Pseudominla castaneiceps: Chestnut-headed Tit-Babbler.

Seen only once on Chandragiri range about 7,000 feet on ropeway path. About twenty of these little birds were quarrelling in a dense mob, extremely noisy. An absolute ball of chattering quivering morsels. I approached close enough to touch them but they were so engrossed in the excitement that they never noticed me, and when finally the mêlée broke up, two tiny birds bumped into me before diving again into the undergrowth. January 23rd.

Pseudominla cinerea: Dusky-green Tit-Babbler.

Seen once only a small flock in jungle above Godavari about 7,000 feet. April 4th.

Leioptila capistrata: Black-headed Sibia.

One of the commonest birds on all the jungle-covered hills. They are found from about 6,000 to about 9,000 feet in the oak forests and do not appear to move at all with the seasons. They seem to differ a good deal in their habits from the Western race—*pallida*—so common round Simla. Here they are found in much larger flocks, and are much noisier, having a variety of chattering screaming notes and a wailing *cheeoo* as well as the sweet whistle so often heard in Simla, but comparatively rarely uttered.

Siva strigula: Stripe-throated Siva.

Fairly common on all the jungle-covered hill-sides from about 6,000 feet upwards. They do not appear to move with the seasons.

Yuhina gularis: Stripe-throated Yuhina.

Abundant on Phulchok from 7,000 feet to the summit where it is one of the commonest birds. Also common on Sheopuri at highest elevations.

Yuhina occipitalis:

Common on the high hills in flocks, particularly so on Sheopuri. I have seen it in winter right down to valley level on Nagar Jong, but never away from jungle.

Ixulus flavicollis: Yellow-collared Ixulus.

A flock on Sheopuri about 7,500 in oak jungle, February 6th. Very tame, keeping up a continual murmuring twitter. In company with tits, willow-warblers and stripe-throated Yuhinas.

Erpornis xantholeuca: White-bellied Erpornis.

Quite common in jungle, particularly at Godavari. Also on Nagar Jong where I have seen them near the summit (7,000 feet) January 9th. after snow and cold, in spite of Landon's list which describes their habitat as 'low hot valleys'. Commonest about 5,000 feet. Usually solitary or in pairs and frequently found in the large parties of tits, willow-warblers, nuthatches, etc., which wander round the hill-sides in autumn and winter. They are unobtrusive little birds creeping about in upper branches of trees.

Leiothrix lutea: Indian Red-billed Leiothrix.

Quite common in winter, in flocks on the jungle-covered hill-sides 4,500 to 8,000 feet. Not noticed in the summer.

Cutia nipalensis: Nepal Cutia.

Scarce. Seen only twice. On Sheopuri about 6,000 feet a pair early June. On Phulchok a small party January 16th at about 7,000 feet. Both times kept to highest branches of tall trees, very quiet.

Pteruthius erythropterus: Red-winged Shrike-Babbler.

Seen several times near the summit of Nagar Jong, 6,800 feet in flocks, together with tits, etc., in oak forest. Not noticed elsewhere.

Ægithina tiphia: Common Iora.

A monsoon visitor to the Nepal Valley. First heard July 18th, at Gauchar. Not noticed after first week in September.

Chloropsis hardwickii: Orange-bellied Chloropsis.

Quite common on all the higher hills. Particularly so at about 7,000 feet, but seen occasionally down to the level of the valley. Never away from the

jungle. Generally in pairs throughout the year, and does not seem to move at all with the seasons. Delightful song, and also mimics other birds. I have heard it mimic the grey drongo exactly.

Minla ignotincta: Red-tailed Minla.

Quite common in winter in jungle. First seen on Sheopuri at about 8,000 feet, November 28th. After that seen often at Sundarijal, 5,000 feet, and Godavari.

Microscelis psaroides: Himalayan Black Bulbul.

Abundant on all the hills. From May to September found in pairs mostly above 6,000 feet. In the autumn they collect into enormous flocks and range along the lower hills being then commonest about 5,000 feet, but found up to 9,000 feet during even the coldest weather. Only occasionally seen in the woods in the Nepal Valley. Godavari, Nagar Jong, and Chandragiri are their favourite haunts and they are comparatively scarce on Sheopuri where the white-cheeked bulbul is found in winter in very large flocks.

Hemixus macclellandi: Rufous-bellied Bulbul.

Very common on all the jungle hill-sides from 4,500 to 9,000 feet. Commonest between 6,000 feet and 7,000 feet. During most of the months of the year in flocks, not so large as the last species, and often found in company with it. A pair carrying nesting material at Godavari, about 7,000 feet. April 24th. Several pairs carrying food May 23rd, Sundarijal, 5,000 feet. Owing to the swarms of leeches in the thick bushes I did not look for the nests.

Alcurus striatus: Striated Green Bulbul.

First seen January 15th. Two birds among a flock of black bulbuls just above Godavari. The next week a number of birds seen at Chandragiri, 6,000 feet, again in company with other bulbuls. They have very sweet whistled notes, quite distinctive from any other bulbul. These might be syllabified as *chee-tu* and sometimes *chee-whittu* or *chee-tu-ti-ti-ti-twee-oo*.

Molpastes cafer: Red-vented Bulbul.

Very common in the Nepal Valley. In pairs all summer, breeds May to July. In autumn collects into large flocks, wandering through gardens and scrub jungle. Not seen in true jungle, but on open hill-sides round the Sanatorium it is found up to 6,000 feet.

Molpastes leucogenys: White-cheeked Bulbul.

Very common on all the hills round the Nepal Valley up to 8,000 feet. They do not move at all with the seasons, but in winter collect in very large flocks. These are particularly common on Sheopuri between 5,500 and 7,000 feet where I have seen literally hundreds together between December and February. A few found at Gauchar throughout the year, but I have seen them nowhere else away from the hills.

Certhia familiaris: Nepal Tree-Creeper.

A small tree-creeper with long, rufous, unbarred tail and white underparts, presumably of this species, seen occasionally above 6,500 feet, on Sheopuri and Phulchok.

Tichodroma muraria: Wall Creeper.

Seen only on an eroded hill-side on Sheopuri, where small mud cliffs have been formed.

Cinclus palasii: Indian Brown Dipper.

Moderately common on stream above dam at Sundarijal. March 28th a young bird seen, it was very tame and allowed us to approach very closely, in spite of anxious calling of parents. It could hardly fly but plunged through and under the water like any old bird.

Saxicola torquata: Stonechat.

Very common in the valley all winter. A very dark bird, brightly coloured below seen occasionally, about 1 in 20 of the paler type. This presumably the Turkestan race—*przewalskii* (?) Between April 5th-14th, thousands passed through on passage. They seemed to be always in pairs—very dark birds, very pale birds, and intermediate. Saw none in valley after mid-April, but several pairs on hill-sides above 5,000 feet. One pair seen in valley at foot of Nagar Jong, with two fully fledged young, August 7th. First seen on return migration September 20th—a female. Not common until October 11th. No large scale passage migration as in the spring.

Rhodophila ferrea: Dark Grey Bush Chat.

Seen only twice. A male on Nagar Jong February 12th, a female in scrub jungle below Sanatorium February 13th.

Enicurus maculatus: Western Spotted Forktail.

A pair usually seen on the Bagmati below the dam at Sundarijal. Also on stream above Sankhu and on jungle streams high on Sheopuri.

Enicurus schistaceus: Slaty-backed Forktail.

Seen on jungle stream on Sheopuri.

Microcichla scouleri: Little Forktail.

In winter one or two usually seen on Bagmati near the dam at Sundarijal, and on the stream above it.

Phoenicurus frontalis: Blue-fronted Redstart.

Very common on all the hills round the Nepal valley all winter. Both sexes have a clicking call rather like castanets *ket-k-t-k-t* uttered continuously. Not seen much after March 22nd. First date in autumn, October 10th.

Phoenicurus hodgsoni: Hodgson's Redstart.

Fairly common in winter in the valley, usually at lower elevations than the last species, and not nearly so common. Very local, birds usually found in the same spot season after season. First date October 27th. They have the same cicada-like note as the last species.

Phoenicurus ochruros: Black Redstart.

Two only seen, both females. In both cases a very dark bird, one on April 5th in a hedge in company with a bluethroat, another April 12th in our garden.

Chaimarrhornis leucocephala: White-capped Redstart.

Common on all streams during the winter. Did not keep dates, but they were common by September 23rd.

Rhyacornis fuliginosa: Plumbeous Redstart.

Common throughout the year on all the hill streams running into the valley. They breed before the monsoon breaks, when the streams become raging torrents. Many young birds strong on the wing round Sundarijal May 28th.

Cyanosylvia suecica: Bluethroat.

Rather a scarce passage migrant, female seen April 5th. It seemed very small and pale. November 19th, three birds together seen skulking in a hedge.

Calliope calliope: Common Ruby-throat.

Only one seen, a male in beautiful bright plumage, April 1st, in our garden.

Tarsiger chrysaeus: Golden Bush Robin.

Seen only on Sheopuri above 6,000 feet in winter. First seen November 28th—fairly common during December to February.

Ianthia cyanura: Red-flanked Bush-Robin.

Fairly common in winter in the jungle on hills above 5,000 feet, November to April.

Ianthia indica: White-browed Bush-Robin.

Scarce, seen a few times in jungle on Nagar Jong, December-January.

Copsychus saularis: Magpie-Robin.

One of the commonest birds in the Nepal valley. Every garden and orchard has several pairs. Not seen on hills. In full song when we arrived end of February. Many nests in holes of walls, houses, etc., in May and June. Most first broods out by mid-June, and the parents singing, courting and quarrelling again, and very aggressive over territory. Most second broods out by early August. Song till end August, when moult started. In full moult by September 21st. Tailless birds all over the place. Did not sing any more till early February, but pairs still faithful to their territory.

Turdus merula albocinctus: White-collared Blackbird.

Common above 8,000 feet during winter on Sheopuri and Phulchok. As we never got up there in summer I do not know whether they breed there or not.

Turdus boulboul: Grey-winged Blackbird.

Fairly common above 7,000 feet, especially on Sheopuri.

Turdus atrogularis: Black-throated Thrush.

Winter 47/48 common in the valley from January to the end of March. First seen December 27th in our garden, but very scarce this winter until the middle of February.

Turdus eunomus: Dusky Thrush.

Large parties on Nagar Jong at about 5,000 feet, spring '48, last date April 18th. None seen in this winter until end of January when odd ones seen in the valley.

Turdus unicolor: Tickell's Thrush.

Fairly common, spring '48. A few pairs remained all summer on hills above Godavari, and I saw a female and fledged young in Gouchar woods in the centre of the valley, August 28th, young still being fed by parents.

Geokichla citrina: Orange-headed Ground-Thrush.

Summer visitor first seen Rani Bagh, April 12th. One pair lived there all summer. May 17th nest found, placed on broad horizontal branch of tree which leaned out from bank about 12 feet from the ground, but level with top of bank, so could be observed easily—three eggs. Parents very shy, and never approached nest while I was watching, but if surprised on nest sat very tight, and did not move even when I was only a few feet away. May 20th, young hatched. June 1st young taken by a Newar as cage birds. Parents remained in Rani Bagh, but did not have a second brood. Very common on Sheopuri Range about 5,000 feet, males singing beautifully early June, also at Gouchar. All left by early September. They are very favourite cage birds in Nepal.

Monticola erythrogastra: Chestnut-bellied Rock-Thrush.

Very common in winter above 6,000 feet. They arrive late. First seen January 9th on Nagar Jong, but saw three pairs that day. After that they were

everywhere Sundarijal, Chandragiri, Phulchok. Always in pairs calling to each other with a curious *quach* note.

Monticola cinclorhyncha : Blue-headed Rock-Thrush.

Very common on the spring migration during April when many seen, both in valley and on hills, particularly Nagar Jong. None seen after the end of April, and none seen in autumn.

Myiophoneus temminckii : Himalayan Whistling-Thrush.

Common on mountain streams at all elevations. Does not move at all with the seasons.

Hemichelidon sibirica: Sooty Flycatcher.

Never seen in the valley, but fairly common on the hills above 6,500 feet. Last date November 2nd on Sheopuri at 8,000 feet.

Siphia strophiata : Orange-gorgeted Flycatcher.

Common in winter on all the hills from 4,500 up to 8,000 even in the coldest weather. First date December 5th. Has a deep chirring note, and also a little monosyllabic *tik—tik* continued endlessly, very ventriloquistic in effect. Males with orange breasts about one to four females or young.

Siphia parva : Red-breasted Flycatcher.

Very common in winter. No birds with red breasts seen until the spring migration when red breasted birds predominated for a short time. Spring migration April 2nd to April 20th. None seen after April 24th. On return migration first seen September 23rd, abundant after 1st October, but none with red breasts.

One male with the whole breast red (presumably sp. *parva*) was seen in Rani Bagh April 11th, again April 14th.

Cyornis tricolor: Slaty-blue Flycatcher.

Not seen in the valley. Several pairs seen during November-December on Sheopuri above 7,000 feet.

Cyornis superciliaris : White-browed Blue Flycatcher.

Seen only on the spring migration. Very common in our garden and in woods in valley between March 17th and April 1st. White eyebrow very conspicuous, so presumably Western race—*superciliaris*. None seen on autumn migration.

Cyornis rubeculoides : Blue-throated Flycatcher.

Very common in summer in all the woods and well wooded gardens in the valley. Not seen on the hills above 5,000 feet. First date April 11th and became common in the following week. Five pairs established themselves in the Rani Bagh, the males singing most beautifully mostly in clumps of bamboos. By May 15th these five all obviously had nests, but very difficult to find as the males never visited them and the females, presumably incubating, never appeared. As soon as young hatch the song of the male changes to a shorter one of only five notes and both birds utter anxious note. Nests soon found as both parents feed. All nests in hollow bamboos between four and twenty feet from the ground. All young out of the nest by June 1st. Fledged young continue with their parents all June—early July. Presumably no second broods. Did not hear them sing after heavy rain started in mid-July. They were common in our garden and in open places during August. All gone by September.

Eumyias thalassina : Verditer Flycatcher.

Common on passage in the valley, but breeds on lower hills. Breeds mostly April-May. First date seen March 25th, all gone by the end of September.

Muscicapa latirostris : Indian Brown Flycatcher.

A few in the valley all summer, our garden, Goucher. Very unobtrusive so it is probably more common than it appears.

Niltava sundara : Indian Rufous-bellied Niltava.

One only seen Chandragiri, October 6th, about 6,000 feet.

Tchitrea paradisi : Himalayan Paradise Flycatcher.

Common in valley during summer, not on hills. Breeds in woods and gardens. First date seen March 19. By end of month all birds collected in breeding areas, and were busy courting and quarrelling over nesting sites. Five pairs bred in the Rani Bagh.

Pair No. 1. Male pure white with long tail.

April 12. Both birds collecting nesting material.

April 17. Nest nearly completed, a cup of grasses, fine roots, bark, a few leaves bound together with spiders' web, and plastered with the last so that it appears quite white. It is placed in fork of small leafless tree, about 15 feet from the ground, not concealed in any way. Female brought fine roots for lining, male did not go near nest.

April 22. Female sitting on nest all morning, the male also took a turn for a few minutes.

May 5. Indian Cuckoo sitting on the branch beside the nest, both parents very agitated. After 5 minutes the cuckoo flew away.

May 12. Nest evidently deserted, so I cut it down. Quite empty. This pair built again immediately in a tree only a few yards from the first nest, about 20 feet from ground. This nest completed May 20, and the birds sat on it occasionally until June 3 when this nest also deserted. They made one last attempt and built again June 17, but this nest was destroyed in a heavy storm when only half built and the birds abandoned it.

Pair No. 2. Male a red bird, central tail feathers about 2 inches beyond rest of tail, sharp line across the breast dividing the black of the head from the white underparts.

April 17. Foundation of nest complete in fork about 35 feet from ground only short distance from the first pair's nest. Both parents work in an ecstacy of excitement, pushing each other off the nest in their haste.

April 22. Both birds working, not much progress made.

May 14. Both parents incubating, changing places fairly frequently.

May 15. As above. The female sits for longer periods than the male.

May 16. Young evidently in the nest. Both parents visit frequently, one always remaining on the nest during absence of the other. Female arrives, sits on rim of nest for some seconds, then appears to give food, but very little, and nothing can be seen in her bill. She then broods for 10 minutes or so till return of male. He also sits on rim of nest, then feeds and waits for return of female, but does not brood.

May 17. Parents now feed immediately on arrival at nest, female broods for about 10 minutes after feeding, male flies off immediately after feeding.

May 18. Much larger particles of food now brought by parents, female only broods occasionally.

May 20. One young can now be seen sticking up above rim of nest.

May 22. Young clearly seen, one larger than the two others. They seem ravenous and clamour for food even when parents nowhere near. This may have been because a large owl was sitting in the bamboos near the nest and all the flycatchers busy mobbing it. It flew off when I approached, but the agitated birds took some time to calm down, and probably had not fed the young for some time. During an hour's watch the female fed the young every five minutes, male sat nearby looking exhausted after the struggle with the owl.

May 24. Three young now clearly visible, one much larger than the others. They often stretch neck and flap wings. Both parents still feed but male only comes occasionally.

May 25. I only had a few minutes to watch. The male flew down and scolded me. This unusual in this placid pair, which have always built, incubated and fed regardless of my presence.

May 26. Young enormous in comparison to size of nest. They sit on edge all round, facing inwards. Backs very pale chestnut the heads dull brown not black. They stretch, preen and flap wings continuously. Both parents busy feeding, very much on the alert, attacking other birds and scolding all intruders. When they utter their harsh *Tst* note the young cower down in the nest and remain perfectly still.

May 28. Young left nest. They keep to the higher branches of the nest tree. Both parents fed them, quite frantic with anxiety scolding and flying at all and sundry.

June 1. Parents still feeding fledged young in high branches, they left the Rani Bagh after this and I did not see them again.

Pair No. 3. Pure white male.

May 16. Completed nest found in tree very close to last nest, about 14 feet from ground, slung in fork of horizontal branch partly concealed by leaves, female incubating, male flew about chivying other birds.

May 20. Female still incubating, male took his turn once but very restless and flew off after a few minutes.

May 23. Female incubated for hour as I watched flying off twice for a few minutes, no sign of male.

May 24. Female incubated 30 minutes then male 10 minutes then female again.

May 25. Female on nest 20 minutes, then male flew into nearby tree and called and female flew off and joined him.

May 26. Female on nest all morning.

May 28. Female on nest, male took a turn for 10 minutes.

June 1. Newly hatched young, female brooding most of the morning but occasionally flew off and returned to feed, but nothing could be seen in her bill.

June 3. Female feeding young, one can be seen peeping above nest, no sign of male.

June 4. During an hour's watch female brought food three times, then brooded 15 minutes; male once flew into tree to scold intruding barbet, but otherwise did nothing.

June 8. Only 2 young, wellgrown, female alone still doing all the feeding.

June 12. Young left nest, could not fly properly, but sat about in the nest-tree: both parents feeding.

Pair No. 4. Pure white male.

May 16. This nest never found, but parents feeding 3 newly fledged young, which could not fly properly, parents very anxious and noisy, mobbing other birds with harsh cries.

May 20. Young still being fed, but not seen in Rani Bagh again.

Pair No. 5. Nest very high in tree above leafy canopy, so could not observe it. Male a red bird, with long central tail feathers.

June 3. 3 young left nest; they remained a week in Rani Bagh, and then disappeared.

All above nests within radius of 25 yards, and I could watch them all from one central position. By June 12 all had taken their young away from Rani Bagh, and I never saw one there again, with the exception of the unsuccessful pair No. 1. They were seen in gardens and open country during July, scarce in August, and all gone by mid September (last date 12th).

General note on nesting. Both parents build beginning of nest, but female alone finishes it. Both incubate, but female does most. Female alone broods, both feed, but female does most, and this varies with individuals. When young leave nest, male takes a larger share. No second brood if first successful.

Chelidorhynx hypoxanthum: Yellow-bellied Flycatcher.

Very common in winter, very tame, in gardens and woods both in the valley and on hills up to 7,000 feet. Leaves early, last date March 20; arrives late, first date November 19.

Lanius nigriceps: Indian Black-headed Shrike.

The common shrike of Nepal, abundant everywhere. Only a few breed in the valley itself, most go up into surrounding hills about 6,000 feet, where they swarm in scrub jungle from mid-May.

May 24. One nest found in valley, a solid cup built in a bamboo about 20 feet, from ground. One bird, presumably the female was sitting and the other brought food.

June 4. The young had left nest and parents feeding them outside. The birds which had bred in the hills began to return to the valley early August, when I heard many singing beautifully. Very common from September onwards, and many young birds about. They remain in the valley all winter.

Lanius tephronotus: Grey-backed Shrike.

Moderately common during winter, both in the valley and surrounding hills. November 3 first date seen; March last seen.

Lanius cristatus: Brown Shrike.

Very scarce passage migrant, March 27 and 31.

Hemipus picatus: Pied Shrike.

Very rare. A small party seen on edge of jungle at foot of Nagar Jong, August 7.

Pericrocotus brevirostris: Short-billed Minivet.

Very common throughout the year, both in the valley and on all hills up to 9,000 feet. They do not appear to move much with the seasons, but in winter collect into huge flocks, which range round the hill-sides. Most nests April and May. Found several but all out of reach. One in our garden on top of an enormous chir pine, several in tall jungle trees on Nagar Jong. Both parents build and feed. Young out by early June and continue all summer with parents. I saw no second broods.

Lalage melaschista: Dark-grey Cuckoo-Shrike

Quite common on hills during summer. Passed through the valley March-April. Bred on hills about 6,000 feet during May-June. After breeding they returned to the valley and were common in our garden July-August. Scarce September and all gone by second week of October.

Graucalus javensis: Large Himalayan Cuckoo-Shrike.

Found throughout year on high hills 5,000-8,000 feet. Also seen occasionally in Nepal valley. Very common at about 6,000 feet near Sanatorium some may leave in winter, but I have seen them during November-January-February above 8,000 feet.

Dicrurus macrocercus: Himalayan Black Drongo.

Abundant in valley throughout the year. In the coldest months they congregate at lower end of valley near Pharing where the river runs out of the valley. Breeds April-June. I found 30 nests, but none within reach. 3 young the average. Nearly all nests in slender fork of tree about 25 feet from ground. Persian lilac a favourite tree. They have very high percentage of success, only one nest of the 30 came to grief and that was blown away in a storm; the birds built again and the second time reared their young successfully.

May 21.—First young out of the nest; several more by May 24. By June 1 families of young everywhere. The amount of white in the young birds seemed to vary a good deal. 6 families reared in Rani Bagh, but most nests in gardens and open country. Last family out of nest by June 6. No second broods. The family parties kept together all June-August. In August they are moulting and are very miserable and quiet (for them). Moult completed by end September and the birds collect in large flocks at any field where the rice is being cut, to catch the small moths and insects which fly in thousands over the damp stubble.

Dicrurus leucophaeus: Himalayan Grey Drongo.

Fairly common on all the hill-sides in the jungle; occasionally seen in the valley in winter. I have seen them in coldest weather at 8,000 feet in January. One nest found half built, April 24, at about 6,000 feet above Godavari. Nest in fork of oak (*Q. incana*). Saw many pairs with young on the wing by end May. Family parties stay together till October. I heard one in

January in the valley exactly mimicking an Oriole. both the liquid *peeóu* note, and the harsh cry of the female oriole.

Dicrurus caerulescens: White-bellied Drongo.

One only seen in Rani Bagh, April 14.

Acrocephalus dumetorum: Blyth's Reed-Warbler.

Quite common on passage April 10-17. Only 2 seen on return passage October 29 and 31.

Acrocephalus agricola: Paddyfield Warbler.

Also seen on spring passage, but I omitted to note the dates.

Orthotomus sutorius: Tailor Bird.

Very common in Nepal throughout the year, not on higher hills. Breeds May-June, and few odd nests during monsoon. 2 nests in our garden and a good many in the Rani Bagh.

Cisticola juncidis: Streaked Fantail-Warbler.

Common in valley during the summer. First seen March 31. April-May common in the bean fields. Once the rice grows up they frequent the rice fields, flying above them in wide circles *tikking*. Seen carrying nesting material (fluffy white down) in July and food in August. They disappeared with this into the rice, and as there is no long grass on the bunds between the fields, they must build in the rice itself, though I never found a nest. I never saw the birds in gardens or woods where long grass does grow. They all disappeared end September.

Phylloscopus affinis: Tickell's Willow-Warbler.

Several seen on passage September.

Phylloscopus collybita tristis: Chiff-chaff.

Fairly common throughout the winter. It keeps to the hedges which bound the fields—the only willow-warbler to do so. I have never heard it utter the *chiff-chaff* call here, only a single note a plaintive *tweet*. Distinct tinge of green in the plumage.

Phylloscopus pulcher: Orange-barred Willow-Warbler.

Very common on all the hill-sides during the winter, being the common willow-warbler above 6,000 feet, though found sometimes in the valley. It is one of the few easily distinguished warblers, the orange wing bar and pale outer tail feathers being very noticeable in the field; the yellow of the rump is not very noticeable. The note is also very distinctive, a high pitched *ti - - ti* repeated continuously, more like the note of a flowerpecker than a warbler. The separate notes are sometimes run together to form a thin insect-like trill. First noticed as common on the high hills early October.

Phylloscopus proregulus: Pallas's Willow-Warbler.

Another easily distinguished willow-warbler, common in the valley all winter, where there are trees—gardens, woods, jungle-covered hill-sides up to 8,000 feet; commonest at about 5,000 feet. Usually in mixed flocks with others of its kind, tits etc. The yellow rump and coronal streak very distinctive. It frequently hovers in front of branches as it feeds. Note, a soft *tsip*. In spring I have also heard it utter a little rapid high pitched song. Most had left our garden by April 1, but a few seen till the 12th. On return seen from October 6 onwards.

Phylloscopus inornatus: Hume's Willow-Warbler.

Very common in Nepal Valley on migration, and throughout the winter. Unfortunately I cannot distinguish between the note of this bird and *P. trochiloides*. Both have a double note *cher wit* or *cherrywit*. If a close view is

The road to Katmandu. Descending the Sisagarhi Pass.

View from Sisagarhi Pass. Ganesh Himal is the snow mountain on the left.

Photos by

Type of vegetation—Sheopuri Lekh.

Author

Bhadgaon with the snows of the Jugal Himal beyond.

obtained Hume's is seen to be smaller and brighter, with a faint coronal streak, but both keep largely to the higher branches of tall trees, so I am unable to tell the relative commonness of the two. Both are however undoubtedly common.

Phylloscopus trochiloides: Green Willow-Warbler.

See last species.

Phylloscopus magnirostris: Large-billed Willow-Warbler.

The note of this bird is quite unmistakable, 5 notes in a descending scale. Heard occasionally on the spring passage. I think I saw it on the return in September, but as it was quite silent then I could not be sure. It has also a very characteristic call of three notes, which is its usual note in its winter quarters in Ceylon, but this is never heard in summer or on passage.

Phylloscopus occipitalis: Large Crowned Willow-Warbler.

A scarce passage migrant. A few seen in the Rani Bagh during the first week in April, uttering the call so familiar in the western Himalayas.

Numerous unidentified willow-warblers swarm through during the spring migration, and again, though not in such large numbers, in the autumn.

Seicercus burkii: Black-browed Flycatcher-Warbler.

Fairly common all winter in our garden, and in woods, bamboo clumps etc. in the valley as well as wooded hill-sides up to 7,000 feet. Not seen after first week in April. Returned October. During coldest weeks—mid December—mid January—disappears from valley and presumably migrates lower.

Seicercus xanthoschistos: Grey-headed Flycatcher-Warbler.

One of the commonest birds both in the valley and on all hill-sides up to 9,000 feet. Found at highest elevations during coldest weather, but a great many leave during December-February returning in swarms end February-March. Its pretty little song is heard throughout the year, but greatly intensified from March to May. Most nests April. One on Nagar Jong had young, April 13; the young left the nest April 18, but many other nests with young early May. Breeding over by June.

Regulus regulus: Himalayan Goldcrest.

Common in winter above 8,000 feet, particularly so on Phulchok (9,200 feet) during December January, in large flocks of 30 birds or more. Keeps up a continuous high pitched squeaking. As I have not been up to these heights in summer, I do not know if they breed there or not.

Oriolus oriolus kundoo: Golden Oriole.

Fair numbers passed through the valley during March and April, but most went on to breed on the surrounding hills. 1 nest found in the valley, the usual deep untidy cup, built in a poplar tree about 20 feet from the ground, May 15. The female was sitting while her mate sat in nearby tree, often calling to her. This nest destroyed in a storm, as well as drongos' nest in same tree, but whereas the drongos built again in the next tree, the orioles disappeared, and I saw no more in the valley until September when the return migration began. Odd ones seen until end Nov., these were all single birds. In spring they migrated through in pairs.

Oriolus chinensis: Black-naped Oriole.

Seen occasionally in the valley during winter (January-February).

Oriolus traillii: Maroon Oriole.

Common in the jungle above Godavari during April and May, when they were in pairs and evidently breeding. I saw one carrying nesting material, but failed to find the nest. Not seen anywhere else, and not noticed in winter.

Sturnia malabarica: Grey-headed Mynah.

Very common in the valley all summer. April 16, first date seen. Many nests in Rani Bagh during May-June in holes in trees, usually 12-20 feet from ground. Nesting over by end June. September-October they collected into enormous flocks which haunted the ripening rice fields. All gone by first week of November.

Acridotheres tristis: Common Mynah.

Abundant in valley everywhere throughout the year. Innumerable nests April-June, mostly in houses, stables, etc.

Æthiopsar fuscus: Jungle Mynah.

Abundant throughout the year, but fewer in winter. Many nests in trees, mostly May-June.

Ploceus philippinus: Baya Weaver Bird.

Common in the valley throughout the year. All the birds I have seen in breeding plumage have yellow on the breast, although this varies a good deal individually. Birds with very little yellow and those with a great deal are found together in the same colonies, and I doubt if there are really two species in the valley as given in Landon's list. Breeding is rather late, commencing end May and continuing to end September, August being a favourite month. Male birds were still busy building nests on September 25, but I do not think any of these were occupied by females. The first colony was at Harisidhi in trees overhanging the village pond. Later there were colonies all over the valley, but very local. A favourite site was the road to Baraniikanti which is planted with lemon-scented gums. Every quarter mile or so there is a colony in these trees of 5-25 nests. They also frequently build in willows along the banks of rivers, and in bamboos near villages. Here there are seldom more than 10 nests together. I watched an amusing incident at one of these, a colony of 7 nests, which on June 17 were all occupied by young birds, which the females were feeding, the males meanwhile building fresh nests about 100 yards away. One male, however, hung about the nests with food in his bill, but every time he attempted to enter the nest with it his wife attacked him furiously and he would retire discomfited and sit on the bamboo spray, where he was chivvied by all the other busy females as they flew back and forth with food. Every time his wife went off to forage he would edge nearer and nearer to his nest but she always returned and saw him off before he could screw up courage to fly into the nest. After nearly an hour of this he at last succeeded and flew into the nest and fed the young, where, judging from the chorus of delighted twitterings he was very welcome. He then flew away triumphantly and returned no more.

By mid November all birds in winter plumage and collected into flocks. They are however much less common than in summer, and probably most migrate to the lower hills and plains.

Uroloncha striata: Hodgson's Munia.

Not very common. A summer visitor, first seen in Rani Bagh April 3. They remained till August, breeding May and June.

Uroloncha punctulata: Spotted Munia.

Very common all the year. They breed late; many nest in August and September, large untidy balls of grass and feathers in trees usually 15-20 feet from the ground. Large family parties in our garden October-February, the young still in immature plumage in the latter month. Usually 5 to 7 young to one pair of old birds, and often several families together.

Carpodacus erythrinus: Common Rose-finch.

Passage migrant. A number of birds went through March 23-25, then I did not see any for some time. April 15 they became very common, and seen everywhere in gardens, etc. quite abundant on Nagar Jong. Most gone by April 20, but odd ones seen till May 8. Females predominate. I noticed very few on the autumn migration.

Procarduelis nipalensis: Nepal Dark Rose-finch.

A winter visitor to the hills above 6,000 feet. First seen January 1 a small party, mostly males, in the scrub jungle on Sheopuri, at about 6,500 feet. Seen often during January-February.

Hypacanthis spinoids: Himalayan Green-finch.

According to Landon's list common in the valley, but I have only seen them a few times. April 29 a flock in my garden. A large flock on Sheopuri about 6,000 feet on May 18, and small flocks at Godavari in December and January.

Passer domesticus: House Sparrow.

Scarce in the valley and a summer visitor; first seen April 12th. Small flocks here and there throughout the summer. Did not see any nests.

Passer montanus: Tree Sparrow.

Abundant throughout the valley and throughout the year. Many nests in our verandah April-June, but many young fell out and came to grief. 2 broods at least.

Passer rutilans: Cinnamon Sparrow.

A few seen April in flocks of tree and house sparrows. Not again.

Emberiza aureola: Yellow-breasted Bunting.

Common passage migrant. First seen April 7 and common till end of the month. Not seen again till early October, when large flock in the rice fields, looking very different in their winter plumage. Common all October, November, early December, but not seen after the cold weather set in.

Melophus lathami: Crested Bunting.

Not noticed in summer. First seen November 11, flocks feeding in the fields where the rice being harvested, and roosting in the hedges at night, in company with tree-pipits. Seen off and on all December, January, February, but very local.

Riparia riparia: Small Sand-martin.

Common all the year along the river banks, particularly so along the Vishnumati.

Hirundo rustica: Eastern Swallow.

Very common in summer, but a few remain all the year. I have seen fair numbers in December, January, February in coldest weather. They roost on wires in one of the little cloth shops in Kathmandu. There are never less than 15 birds all through the winter. They are very tame and though almost on a level with people's heads appear quite indifferent to human beings. The owner tells one with pride that they come to his shop from all over the valley. They become absolutely abundant during March, but many are only passage migrants, and disappear in April. Nesting begins in earnest in April. All nests I have seen were right inside houses, usually attached to the wall of the upper story. First young seen on the wing May 30. Second broods June July. The majority leave August, September. I did not notice any large influx of passage migrants in the autumn, as in spring.

Hirundo daurica: Red-rumped Swallow.

The commonest swallow in the summer. They arrive late, few being seen before April 14, and not common before 20. They also build inside the houses and certainly have more than one brood. I have seen them feeding barely fledged young on September 6. Common till end of October when most left. I have seen a few hawking over the gorge at Chorban on February 5 and several in Kathmandu, February 9 and 10. The colour of the rump varies a great deal, and though most have a light rufous rump, paling towards the tail,

some have almost pure white rump, and in some it is a deep rufous throughout. I do not know if the colour is affected at all by the age of the bird. They are very tame and frequently alight on the damp sand along the river banks when an excellent view can be obtained.

Motacilla alba: White Wagtail.

At least two forms, *M.a. alboides* and *M.a. leucopsis*, common throughout the winter. Birds with black backs are seen all winter, being in the proportion of about 1 to 3 of all other kinds. I have always understood that black backs were only seen in breeding plumage, so find this puzzling. There are also of course numbers with black heads and grey backs (females?) and with grey heads and grey backs (young?) During the spring migration they swarm along the river banks. April 10-17 was the height of the migration, I counted thousands all along the Vishnumati. Only a few April 20; by April 24 not one bird anywhere. On the return migration none seen till September 19 and not common till 25, never the large flocks of the spring. All winter they are quite common both on the river banks and in all the ploughed fields.

Motacilla madaraspatensis: Large Pied Wagtail.

Very scarce in the valley. Only 1 pair seen in the summer, which frequented the stream near Harisidhi village from May 9 onwards. June 5 nest found, built on ledge of the bridge, well concealed by a clump of grass. It contained 3 young.

During the winter saw 2 birds only in January, both solitary.

Motacilla cinerea: Grey Wagtail.

Not common, but a few remain in the valley all winter. Very local. There is always a bird at the dam at Sundarijal and another on the stream at the foot of Sheopuri. No extra birds noticed during the migrations.

Anthus hodgsoni: Indian Tree Pipit.

Abundant all winter, both in the valley and on all the hills up to 9,000 feet. Start to leave early in April and all gone by May 1. On return first seen October 7; common by 14th.

Anthus rufulus: Indian Pipit.

Common throughout the year in valley. Nests during April and May in the wheat fields. We found a good many nests with eggs May 5-25 but these were all destroyed as the wheat was harvested. When the monsoon breaks the pipits desert the fields and are then common at Goucher and on open hill-sides.

Anthus campestris: Tawny Pipit.

Fairly common throughout the winter in the wheat fields. First date seen October 11.

Oreocorys sylvanus: Upland Pipit.

Common throughout the year on open hill-sides above 6,000 feet always found on the grass slopes above the sanatorium. Does not move at all with the seasons, and never seen in valley. Breeds May. Its note is very characteristic, and sounds like a gate swinging on rusty, squeaking hinges.

Alauda gulgula: Little Skylark.

A winter visitor only, when small flocks frequent the rice fields. Not noticed much before December.

Zosterops palpebrosa: White-eye.

Very common all summer and a few remain all the year. Very many nests found April and May. 8 nests in Rani Bagh and others in gardens and scrub jungles. 2 eggs in all cases. Most nests 6 to 8 feet from ground, but two over 20 feet. All young left the nest during second fortnight of May. Did not see any second broods.

Æthopyga siparaja: Yellow-backed Sunbird.

Scarce, a few seen in Rani Bagh during April. None in summer. A young male, with very red throat was being fed by parent (female) in Nagar Jong jungle (4,500 feet) October 11. Several immature birds seen in our garden in October; none in winter.

Æthopyga gouldiae: Mrs. Gould's Sunbird.

The common sunbird of the hills above 6,000 feet where it is abundant in the oak forests throughout the year. Never seen in the valley, but I have seen it at 9,000 feet in coldest weather with snow on the ground.

Æthopyga ignicauda: Fire-tailed Yellow-backed Sunbird.

A bird which I take to be of this species, was common on Chandragiri above 6,000 ft. during January and February. They were in pairs, the males in eclipse dress which is not described in Stuart Baker. Head, chin, throat grey, the crown streaked darker. Breast yellow, with tiny patch of vivid scarlet in centre, rest of lower parts greenish, rump bright yellow. Upper tail coverts and tail brilliant jewel-like crimson.
They were feeding on a flowering jungle tree.

Cinnyris asiaticus; Purple Sunbird.

Arrives in the valley in considerable numbers in June. First seen in our garden June 1, and common by end of the month. They apparently breed in the lower hills and visit the valley after breeding. When they first arrived there were a fair number of males in breeding plumage, but by July only females and males in eclipse dress were seen. Common all July-August, all gone by end September.

Dicaeum ignipectum: Fire-breasted Flowerpecker.

Seen on hills above 6,000 feet in summer, sparingly in valley in winter, not common anywhere.

Dicaeum erythrorhynchos: Tickell's Flowerpecker.

Common all summer. All leave in winter.

Piprisoma agile Thick-billed Flowerpecker.

Very common all summer all over valley and on hills to 7,000 feet. All gone by end October.

Picus canus: Assam Black-naped Woodpecker.

Quite common in the valley throughout the year, also on lower hills.

Chrysophlegma flavinucha: Large Yellow-naped Woodpecker.

Fairly common on the hills, particularly on Nagar Jong, also in the Goucher woods all summer. Not noticed during the cold months.

Dryobates darjellensis: Darjeeling Pied Woodpecker.

The common woodpecker of the higher hills, above 7,000 feet all the year. Very common on Phulchok, Sheopuri.

Dryobates cathparius: Red-breasted Pied Woodpecker.

Seen once only on Phulchok at about 6,000 feet in January.

Dryobates macei: Fulvous-breasted Pied Woodpecker.

The common woodpecker of the valley and the lower hills up to about 7,000 feet throughout the year, particularly common on Nagar Jong.

Dryobates auriceps: Brown-fronted Pied Woodpecker.

Fairly common on the lower hills, especially Nagar Jong, between 4,500 and 7,000 feet, all the year. Also occasionally in the valley.

Micropternus brachyurus: Northern Rufous Woodpecker.

Seen once only, in chir pine woods below Sanatorium about 5,500 feet, May 17.

Picumnus innominatus: Himalayan Speckled Piculet.

Seen occasionally on Nagar Jong during summer; not noticed in winter.

Megalaima virens: Great Himalayan Barbet.

Common on all the hills in the oak forests above 6,000 feet throughout the year.

Megalaima asiatica: Blue-throated Barbet.

Very common in the valley throughout the year, though the numbers lessen during the coldest weather, not seen much above 6,500 feet on the hills. Many nest in the Rani Bagh, April and May all in holes in trees above 25 feet from ground and quite inaccessible.

Megalaima franklinii: Golden-throated Barbet.

Rather scarce, but several seen in the oak forests above Godavari during the summer.

Megalaima haemacephala: Indian Crimson-breasted Barbet.

Monsoon visitor to the valley. Only seen at Goucher and in the Rani Bagh, never on the hills. Arrived June and left end August.

Cuculus canorus: Eastern Cuckoo.

Common on all the hill-sides above 5,000 feet. First heard on Nagar Jong April 11 and abundant there all summer. Called *cuckoo* until end of June; not heard after that, though often seen on lower hills and sometimes in valley. Many pass through on migration during September and October when they frequent the willow trees growing on banks of Vishnumati, which are infested with caterpillars.

Cuculus optatus: Himalayan Cuckoo.

Common in the summer on all the jungle hills above 5,000 feet constantly heard but seldom seen. Never heard in the valley except on passage. One haunted the Rani Bagh from March 28 to 31.

Cuculus micropterus: Indian Cuckoo.

One of the commonest birds during the summer in the valley, not on the hills. First heard April 2 and after that abundant in our garden, Rani Bagh, and Goucher. Called continuously all April. May June, not so frequently after middle of last month, heard occasionally July, after that silent, but seen in Goucher woods till end August. In spite of being so common I failed to find any eggs. I once saw one sit beside paradise flycatcher's nest. This nest was subsequently deserted by the flycatchers. Twice saw it in Rani Bagh, carrying an egg in its bill but whether its own, or one robbed from another bird's nest I could not tell. In June saw a paradise flycatcher feeding a young one, but that was the only young cuckoo I saw. I cannot think the paradise flycatchers are the usual fosterers, as all the nests in the Rani Bagh successfully reared young flycatchers, at a time when these cuckoos were all over the locality.

Hierococcyx varius: Common Hawk-Cuckoo.

Very scarce in valley. Only recorded twice, April 13 on Nagar Jong 5,000 feet, and April 20 in our garden.

Clamator jacobinus: Pied Crested Cuckoo.

Once only April 24 in our garden.

Eudynamis scolopaceus : Koel.

Abundant all summer. First heard March 26 and from then onwards a perfect menace, waking us up at 3 a.m. with its fiendish screams. We shot a great many, which would result in peace for a night or two, but fresh birds soon took the dead one's places. Noisy all April, May, June, both the *koél* and water bubbling note. Only occasionally heard in July and completely silent after the third week. Still common August and September but moulting and silent. 3 or 4 females often seen together feeding in wild pear trees. I was surprised to hear the familiar *koél* call on September 12 when they had been silent a long time, but on looking up saw a young bird being fed by a crow. After being fed it followed the crow about, flapping its wings and uttering low conversational notes. It did not cry *koél* again. All gone by October.

Rhopodytes tristis: Large Himalayan Green-billed Malkoha.

Seen once only on Nagar Jong at about 6,500 feet on January 8. Very tame, creeping about in the bushes.

Psittacula himalayana : Himalayan Slaty-headed Paroquet.

Fairly common on the lower hills round valley; occasionally in valley itself.

Psittacula cyanocephala : Blossom-headed Paroquet.

Moderately common on hills round valley, especially Nagar Jong.

Ceryle lugubris: Himalayan Pied Kingfisher.

This lovely bird seen once only on the dam at Sundarijal December 8. I got a very good close view.

Alcedo atthis : Common Kingfisher.

Scarce in valley, but a few seen throughout the year. Usually one on the Bagmati near Goucharan, and one on the pond in Bagmati village.

Halcyon smyrnensis : White-breasted Kingfisher.

Very common in valley. Most leave in the coldest months, but in summer abundant everywhere. Breeds during monsoon, July-August. We often saw them carrying food into holes in the mud cliffs. Many young birds about, September-October, but these never with their parents. They were often so tame that one could get right up to within a few feet of them.

Upupa epops : Hoopoe.

Rather scarce passage migrant; very local. One bird haunts a small group of trees on the banks of the Vishnumati. I have seen it there off and on from mid-October—mid-April for two winters. Seen elsewhere only September 11 and October 7.

Micropus affinis : Indian House Swift.

First seen February 29, after that common. Built under eaves of houses May-July. Left valley August and September.

Collocalia fuciphagā : Himalayan Swiftlet.

Seen occasionally flying over Nagar Jong.

Caprimulgus macrourus: Horsfield's Nightjar.

Heard the familiar call (which always sounds to me like paddy being pounded) in the Rani Bagh in mid-April. It remained in the Rani Bagh till the end of the month. I saw it several times in broad daylight, and got an excellent view, as it was very tame. Not seen or heard after May 1. This year my husband writes that he heard it as early as the 13th March.

Strix indranee: Brown Wood-Owl.

A pair in the Rani Bagh all summer. When they were feeding young during May and June I frequently saw them during the day, when they were furiously mobbed by paradise flycatchers, drongos, mynahs, etc. In early June some children caught a young one, it could not fly, but the children said it had fluttered down from a hole in a thick dead tree. The hole was about 25 feet from the ground. I bought the owl from the children and later put it into a thick clump of bamboos which was a favourite roosting place of the parent owls. The young one was covered with the softest pure white down. It continuously snapped its bill with a clicking sound, but made no real attempt at biting us. I did not see it again, but in July saw the parent owls with one young one just able to fly, whether this or another of course I could not tell.

At least two varieties of owlet are common, one in gardens, and another in the jungle, but I have not identified them.

Ninox scutulata: Indian Brown Hawk-Owl.

A pair frequents our garden throughout the year, but they only call during the summer. Then their curious *coo-ock, coo-ock* is heard regularly just at dusk as they leave their roosting place, and again early in the morning. They roost together, sitting cuddled up close together, and return night after night to the same spot. They are very tame during the day, and one can get very close to them.

Pandion haliaëtus: Osprey.

Seen off and on throughout the year. One frequently perches in the huge chir pine at the bottom of our garden. It sometimes brings a fish and eats it there. As there are no lakes and the rivers only contain fish of the 'whitebait' variety, it is rather mysterious where it gets them from, unless it robs masheer from the royal ponds.

Sarcogyps calvus: King Vulture.

Fairly common throughout the year.

Pseudogyps begalensis: Indian White-backed Vulture.

The common vulture of the valley, becoming scarcer in the coldest months. Goucher is a favourite haunt of theirs, and they breed in the tall trees there.

Gypaëtus barbatus: Lämmergeier.

Scarce in the valley, but seen occasionally soaring over Nagar Jong, Godavari or Sheopuri. On February 13 I saw 2 birds over the last hill—a magnificent sight as they wheeled round each other in great circles.

Falco peregrinus: Eastern Peregrine Falcon.

A winter visitor. A single bird lived in the embassy grounds during the winter of 1947-1948. This year a pair arrived October 20, (1948) and have been here ever since. They leave early April. They feed on the pigeons which are very common. In the evenings, after feeding all day in the fields, the pigeons flight past the embassy on their way to roost on the temple roofs in Kathmandu. The peregrine usually brings his prey to one of the tall chir pines in our garden where he devours it at his leisure. I have never seen him feed except in the evening.

Falco severus: Indian Hobby.

A summer visitor. The *ki-ki-ki call* (so familiar from Kashmir days) first heard May 29, and we presently saw the hobby flashing through the garden to alight on one of the tall chir pines so popular with eagles and falcons. It proved to be the above species and not *F. subbuteo* of Kashmir memories, but I find the notes of the two indistinguishable. It remained throughout the summer and had a nest during July-August in a tall pine in the embassy grounds. I often watched it carrying food to the nest, but could not see the nest properly. Last date seen carrying food August 20. They disappeared during last week of September. This year (1949) my husband writes that it arrived April 4.

Falco chiquera: Red-headed Merlin.

Throughout the year in the valley; rather scarce.

Falco tinnunculus: Kestrel.

A winter visitor and arrives very late. First date seen November 11; very common by November 15. They are seen all over the valley, but are particularly common at the lower end near Chorban. Last date seen April 12. They are all extremely pale, no slaty in the male and the female very pale rufous, so I suppose the European race *tinnunculus*.

Aquila nipalensis: Steppe Eagle.

Fairly common in winter, mostly the phase with white bars in the wing. Other eagles, not identified specifically, are common during the winter.

Ictinaëtus malayensis: Indian Black Eagle.

Seen throughout the year, but only flying over the jungle hills never in open country or in the valley. It is the common eagle of the jungle from 4,500 to 9,000 feet.

Hawk-eagles with white breast often seen in the hills, but not identified for certain.

Spilornis cheela: Crested Serpent-eagle.

Fairly common in summer. A pair always at Godavari April-June where they always roost in the same large tree. Often seen soaring in pairs over the hills above Godavari, also over Nagar Jong. They appear to leave in winter. I have not seen one after September.

Haliastur indus: Brahminy Kite.

A summer migrant, arriving late when the rice is well grown. I did not see one before August. Very local; frequenting the same patch of rice fields throughout its stay. Left end September.

Milvus migrans: Common Kite.

Abundant throughout the year.

Circus macrourus: Pale Harrier.

Seen occasionally on spring passage.

Circus pygargus: Montagu's Harrier.

On passage only. Several during April. One only on the autumn migration—a male, November 3.

Circus cyaneus: Hen Harrier.

A pair frequented the fields near the Embassy during March and April. They hunted alone during the day, but always roosted near each other in the bean fields on the banks of the Vishnumati. Not seen during the autumn and winter.

Circus aeruginosus: Marsh Harrier.

The commonest harrier in autumn and winter, usually immature or females. I have seen only one male in full adult plumage. First date September 5.

Buteo rufinus: Long-legged Buzzard.

Buzzards (I think of this species) common during the winter. First date September 7. They leave in April. The dark phase the most common, but I have seen an almost pure white one near the Chorban gorge in January and another very pale bird frequented our garden all January and February.

Accipiter nisus: Sparrow Hawk.

Common in winter. First date October 14. A pair haunted our garden and were so destructive in stealing our chickens that we were obliged to shoot them. They proved to be of the above race. Almost pure white below, very finely barred dark brown. A faint tinge of buff on the flanks of the female, none on the male. He was considerably smaller than his mate and did less damage amongst our chickens. I have seen them hunting along the hedges between the fields, slipping from side to side with wonderful speed and neatness. They cause wild panic amongst the flocks of little birds. I have watched a magpie robin escape with a squeal of terror, quite unlike its normal note.

Streptopelia orientalis: Rufous Turtle Dove.

Summer visitor, quite common in the Rani Bagh and on the surrounding hills. First date March 17.

Streptopelia chinensis: Spotted Dove.

Very common.

Œnopopelia tranquebarica: Red Turtle Dove.

Not very common. A summer visitor seen here and there in the valley from April to September.

Fulica atra: Coot.

A pair on Bhatgaon tank January 8. The only time seen.

Charadrius dubius: Jerdon's Little Ring-plover.

Seen occasionally on sandy shingle beds in the Bagmati and Vishnumati between March-October.

Lobivanellus indicus: Red-wattled Lapwing.

Very common during the monsoon, and a few remain throughout the winter.

Lobipluvia malabarica. Yellow-wattled Lapwing.

Seen occasionally during the monsoon.

Numenius arquata: Eastern Curlew.

Seen once only, at Goucher August 21.

Tringa ochropus: Green Sandpiper.

A winter visitor and passage migrant. First date August 17, last date April 17. Those which remain all winter are very local and are to be found throughout their stay in little groups of 2 to 7 birds frequenting the same short stretch of river bank. Large numbers pass through on migration. September 16 saw numbers flying through calling, usually 3 birds to a party. I counted over 20 parties during an afternoon's walk, all flying steadily in the same direction. September 21 again saw numbers flying past.

Actitis hypoleucos: Common Sandpiper.

A few on all the river banks, generally 1 or 2 to each mile of bank; these numbers remain constant throughout the winter. During the migrations many more are seen. First date August 8, last date April 27.

Scolopax rusticola: Woodcock.

Rather scarce winter visitor.

Capella gallinago: Fantail Snipe.

Capella stenura: Pintail Snipe.

Fair numbers on passage, and a few all winter. All that I have seen shot were fantail.

Lymnocryptes minima: Jack Snipe.

Scarce passage migrant, probably a few all winter.

Dissoura episcopa: White-necked Stork.

Seen occasionally throughout the year.

Egretta garzetta: Little Egret.

Not so common as the next species, but remains throughout the year. Usually solitary or in pairs, but I have seen it in small flocks in winter. Breeds in tall trees in small wood near Godavari. May 30 could see the birds on their nests but foliage too thick to make out any details. Pond herons breeding in same trees.

Bubulcus ibis: Cattle Egret.

Abundant all summer in flocks. Most leave during the cold weather. A huge breeding colony in Kathmandu itself, in two large peepal trees. All birds fledged and ready to fly in this colony by July 20. Another smaller colony in Harisidhi village, in peepal tree over the village pond. May 20 the birds were repairing last year's nests, some already had eggs. May 31 most nests had incubating birds. 52 nests occupied this colony.

Ardeola grayii: Indian Pond heron.

Abundant throughout the year. Birds in breeding plumage from June to September. Most breeding colonies occupied end June-August.

Nycticorax nycticorax: Night Heron.

Very common throughout the year. Did not find any breeding colonies, but many immature birds about all autumn, and unlike the parents which do not appear till dusk, these young birds are seen standing about in the fields all day.

Anas penelope: Wigeon.

A male shot by Newars May 15.

Anas crecca: Common Teal.

Abundant during the migrations. Little flights crossing the valley all day from last week August till mid October. Most birds during first week of October. They only remain in the valley a few hours, sometimes a day or two. During the spring migration most went through in April, but never in such numbers as in autumn.

Aythya ferina: Pochard.

January 8 a male on small tank at Bhatgaon.

Duck and teal fly through in thousands during the migrations, but as there are very few suitable places for them to alight, most go through without stopping. Numbers of teal are shot, but very few duck.

THE INSECT FAUNA OF A COTTON FIELD AT LYALLPUR

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(With a plate)

SYNOPSIS

A knowledge of the insect fauna of a cotton field in any particular locality is of very great importance for the proper assessment of the damage done by them in different seasons. The population of the different species of insects varies with changes in the climatic conditions. A thorough study of this problem at Lyallpur during 1945 and 1946 revealed that the insect fauna of both *desi* (*Gossypium arboreum* Linn.)and American cotton (*G. hirsutum* Linn.) fields was similar, with the exception of cotton jassids (*Empoasca devastens* Dist.) which were in great excess in the fields of American cottons, particularly in the former year, when heavy rains were received. The Cotton Boll-worms (*Earias insulana* Boisd.) causing 10-20% loss of crop, however, was in abundance in the drier season and on *desi* cotton. The Cotton White-fly (*Bemesia gossypiperda* Cam.) another serious pest of cotton, due to its very small size, could not be collected. Its attack is rather serious in hot and dry seasons. The hymenopterous insects cause indirect loss to the crop by natural cross-pollination.

* * * * *

INTRODUCTION

Lyallpur is situated in the heart of the canal colony areas of the West Punjab and is the most representative of all these districts. Its climate is hot and dry during April, May and June. Hot winds are very common during summer and there are usually 10-15 severe dust storms. A short spell of monsoon weather follows, during late July and August. September and October are mild and dry and winter is cold. First frost occurs in the 3rd week of December and there are no frosts after the 15th of February. Light showers are usually expected during Christmas and early January.

Such climatic conditions coupled with sound, perennial irrigation have helped in the development of the canal colony districts as the most flourishing of the entire area. Cotton is the most important cash crop of these areas and wheat, gram, oilseeds and sugarcane etc., are only of secondary importance.

Both the local and the American cottons belonging to *G. arboreum* race *bengalense* and *G. hirsutum* respectively are being grown over large areas, but the latter ones are by far the most important, covering approximately 90% of the entire area under cotton.

39 *Mollisoni* and 4F, the two varieties belonging to the local and the American group of cottons respectively, have been holding the field for a fairly long time. It may be mentioned that both *desi* and American cottons always give very high yields and always bring good returns to the growers, but crop failures are not un-

common due to occasional serious attacks of certain insects, like cotton jassids, cotton boll-worms, and the cotton white-fly. The extent of damage done, varies with the weather and climatic conditions which have a direct bearing on the multiplication or reduction of a particular set of insect species.

For a proper appreciation of the damage done to cotton by insects, the knowledge of the insect fauna of a particular locality is very important, and for this purpose a collection of insects was made every 4th day from fields of both 39 *Mollisoni* and 4F by sweepings with a hand net. Sixteen forward and sixteen backward strokes of the hand net were made as described by Verma and Afzal (1) from 20th August to 21st November during the two cotton seasons, 1945 and 1946. The daily total number of insects collected is given in Table I.

TABLE I

Daily insect collection from fields of cotton

Dates	Number of insects collected			
	39 *Mollisoni*.		4F.	
	1945	1946	1945	1946
20. 8.	1	10	52	19
23. 8.	15	7	74	30
26. 8.	16	13	37	30
29. 8.	13	9	28	24
1. 9.	9	11	50	17
4. 9.	13	9	100	17
7. 9.	16	9	204	24
10. 9.	11	7	57	24
13. 9.	9	10	36	19
16. 9.	12	10	17	22
19. 9.	7	7	14	21
22. 9.	9	12	16	22
25. 9.	10	7	13	29
28. 9.	17	11	37	32
1. 10.	11	12	19	30
4. 10.	10	10	17	24
7. 10.	8	11	17	23
10. 10.	13	8	17	21
13. 10.	9	10	17	14
16. 10.	7	7	30	13
19. 10.	9	9	14	17
22. 10.	12	8	9	14
25. 10.	11	6	11	12
28. 10.	9	7	14	12
31. 10.	3	8	10	21
3. 11.	11	7	13	14
6. 11.	7	7	19	11
9. 11.	9	7	27	14
12. 11.	9	5	20	10
15. 11.	11	4	21	10
18. 11.	4	2	13	6
21. 11.	6	1	12	2
Total ..	327	261	1,036	598

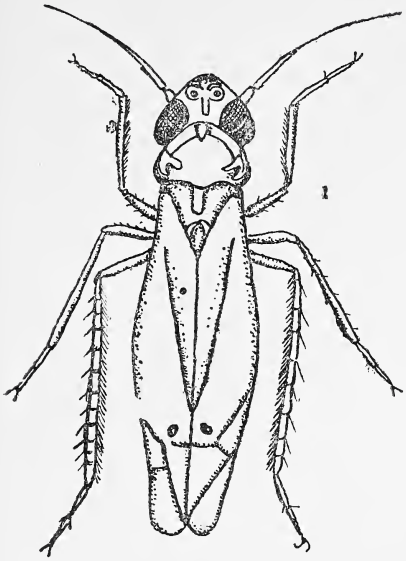
It will be seen from Table I that the number of insects present during 1945 in both 39 *Mollisoni* and 4F was more than in 1946. It was due to heavy rains received which resulted in a higher humidity during the greater part of the first cotton season. It is clear that the American cottons harboured a much larger number of insects than *desi* cotton. It will be further seen that the number of insects in both *desi* and American cottons, particularly in the latter case, was very high up to the end of September, after which it showed a marked decrease and in the third week of November, it was very low indeed. The insect collections were classified and the number of different species is given in Table II.

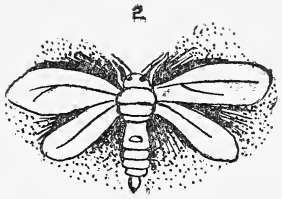
TABLE II

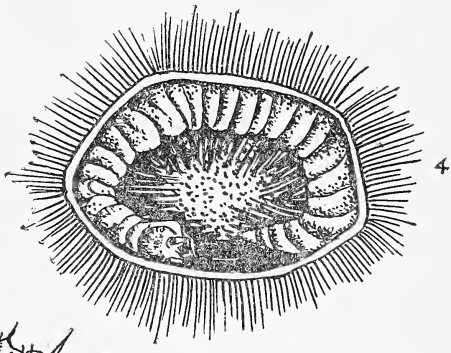
Classification of insects found in cotton fields

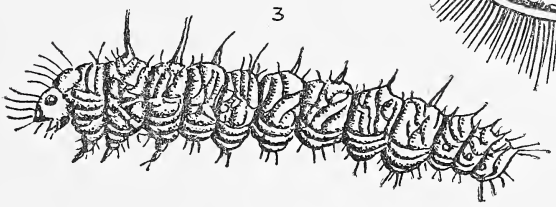
Species	Order	Population			
		39 *Moll.*		4F.	
		1945	1946	1945	1946
Empoasca devastens Distant ...	Rhynchota ...	90	48	824	342
Brumus saturalis Fabr. ...	Coleoptera ...	66	34	44	63
Myllocerus 11—*pustulatus* Fst	Coleoptera ...	35	48	58	22
Earias insulana Boisd. ...	Lepidoptera ...	29	62	19	53
Apis dorsata Fab. ...	Hymenoptera ...	13	4	8	4
Chrysopa sp ...	Neuroptera ...	12	16	39	36
Leptocentrus tannus Fabr. ...	Rhynchota ...	11	7	1	4
Grasshopper ...	Orthoptera ...	7	2	3	2
Mutilla sp. ...	Hymenoptera ...	6	7	4	17
Myllocerus blandus Fst. ...	Coleoptera ...	4	4	2	3
Dysdercus cingulatus Fabr. ...	Rhynchota ...	4	1	2	1
Danais chrysippus Linn. ...	Lepidoptera ...	4	...	...	...
Musca domestica Linn. ...	Diptera ...	4	2	3	2
Pieris brassicoe Linn. ...	Lepidoptera ...	3	...	3	...
Nomada sp. ...	Hymenoptera ...	2	3	7	6
Sarcophaga ...	Diptera ...	2	...	2	1
Cardiophorus sp. ...	Coleoptera ...	1	1	...	2
Anthrenus subclaviger Peit. ...	... ...	1	...	...	1
Utetheisa pulchella Linn. ...	Lepidoptera ...	1	...	...	6
Orthetrum anceps Schu. ...	Odonata ...	1	...	...	1
Andrena ilerda Cam. ...	Hymenoptera ...	1	...	1	2
Icaria ferruginea Fabr. ...	Hymenoptera ...	1	1	...	2
Chalcis techardiae Cam. ...	Hymenoptera ...	...	1	1	...
Zygoptera ...	Odonata ...	...	5	1	2
Macropes sp. ...	Rhynchota ...	...	1	1	1
Paederus fuscipes ...	Coleoptera ...	...	2	3	...
Salius flavus Fabr. ...	Hymenoptera ...	...	1	1	...
Clasposoma auripenne Baly. ...	Coleoptera ...	...	1	...	1
Spider ...	... ...	7	5	6	1
Chrysis indica Mocs. ...	Hymenoptera ...	...	...	...	2
Anthophora confusa Smith ...	Hymenoptera ...	...	...	...	2
Unclassified ...	... ...	1	12	1	16
Total ...		327	261	1,036	598

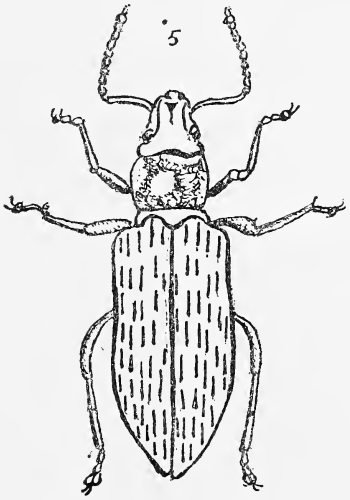
It will be seen from Table II that the insect fauna of both *desi* and American cotton was similar, except that the number of cotton

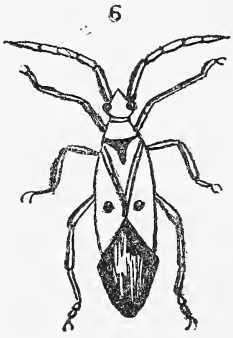












1. *Empoasca devastens* Dist. × 10½; 2. *Bemesia gossypiperda* Cam. × 11¼;
3. *Earias insulana*. Boisd. × 2¾; 4. *Platyedra gossypiella* Saund. × 3½;
5. *Myllocerus* 11—*pustulatus* Fst. × 7; 6. *Dysdercus cingulatus* F. × 2⅓.

jassids (*Empoasca devastens* Distant) was much more on American cotton than on *desi* cotton and in the season 1945 than in 1946 and that the disparity in total number of insects from two fields was entirely due to this insect. It is well known that jassids are a major pest of American cottons in the Punjab, while *desi* cottons are practically immune to it. The bigger number of jassids on 4F is therefore according to expectation.

It may be mentioned here that the larger number of cotton jassids during 1945 resulted in the loss of yield in 4F by 3 maunds and in the case of Victory (124F) by 10.28 maunds per acre at Lyallpur. The differences in yield in the case of *desi* cotton were negligible. This is a huge loss indeed and calculated in terms of money, it comes to crores of rupees.

Another interesting point brought to light was that there was a general higher trend in the population of all the species during 1945 as compared with 1946, except for the number of cotton boll-worms (*Earias insulana* Boisd.) which showed greater number during 1946 and its population was slightly more in 39 *Mollisoni* than in 4F. It is further clear from the data given above that both *desi* and American cottons were more or less equally attacked by boll-worms and that the lesser number in 1945 was due to the heavy rains, which checked their multiplication. The losses due to boll-worm attack are serious in certain seasons and range from 10 to 20%.

It will be interesting to note that the cotton white-fly (*Bemesia gossypiperda* Cam.), which is also considered a major pest of cotton in the West Punjab did not find a place in Table II. This is probably due to the very small size of this insect, which makes its proper collection rather difficult. It is present on the cotton plants in huge numbers in hot and dry seasons, and heavy rains are considered helpful in checking its attack. The losses due to the attack of this insect during 1945 and 1946 were, however, not so serious.

Apart from the loss in yield from the damage directly done to the cotton crop by the insects mentioned above, there is an indirect loss brought about by the hymenopterous insects. These insects bring about general deterioration in the cotton crop, by natural cross-pollination. It has already been shown by Afzal and Khan (2 & 3) that there is about 2% of natural crossing in cotton in contiguous plants and rows and 0.05% under field conditions at Lyallpur. The most active agents of natural crossing were found to be *Apis dorsata* Fab., *Anthophora confusa* Smith and *Elis thoracica* Lepel.

It may be mentioned here that most of the hymenopterous insects are extremely active and agile and that is the reason, why their collection by the sweepings method mentioned earlier has not proved of much use.

The data presented in this paper has revealed an interesting picture of the insect fauna of a cotton field at Lyallpur. It may be taken as a representative one for all the canal colonies. The important pests and cross-pollinators have been brought to light.

Similar records from other parts of the Indo-Pakistan sub-continent would make very interesting comparisons.

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BOMBAY CROP PESTS CALENDAR AND A SEASONAL SCHEDULE OF THEIR CONTROL BY MODERN INSECTICIDES

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INTRODUCTION

For the last several years there has been a growing demand especially from educated farmers, orchard owners, rural development staff, district and propaganda officers as well as the students of agricultural colleges and schools for a handy, comprehensive and up-to-date crop pest calendar for the Bombay Province, giving a schedule of control measures by the use of modern insecticides. Prior to this, Dr. Ayyar at the 4th Entomological Meeting held at Pusa during February 1921 had suggested the need for preparing such calendars for each province of India. In the absence of such a work in this Province, the present article is a modest attempt at meeting this pressing need of the day.

In this Province, there are diverse agricultural practices and as such, certain crops are cultivated either in *Kharif* or *Rabi* or in both the seasons. Thus, the appearance of pests here in particular months would not hold good for other localities. However, in order to simplify the matter, the crop pests are arbitrarily classified according to their periodical appearance in crop fields, as well as under the categories of their nature of occurrence such as (*a*) Regular seasonal crop pests (*b*) Occasional sporadic crop pests, and (*c*) General crop pests found all the year round.

The control measures recommended against the crop pests are through personal experiences of the authors, who have gathered them through preliminary trials. For the benefit of the rural public they have attempted to set them out in this article.

A. REGULAR SEASONAL CROP PESTS

Mid-March to mid-June.

(i) Protect your summer cucurbits against Pumpkin Beetles (*Aulacophora abdominalis*) by dusting a mixture of Pyrodust 4,000 and Guesarol 405 (DDT 5%) dust, mixing in proportions of 1 : 1 at 15 to 20 days interval. (ii) Preserve the *seed* potatoes by dusting them with Geigy 33 A-5 (DDT 5%) against the Potato Tuber Moth (*Gnorimoschema operculella*), at the rate of 1½ ounces per 80 lb. of potatoes. (iii) For the Spotted Bollworm (*Earias fabae*) on Bhendy, cotton and Brinjal fruit borers (*Leucinodes orbonalis*), spray 0.2% DDT-water suspension (Guesarol 550) at fortnightly intervals. (iv) After April-pruning of grape vines, the Udadya Beetles (*Scelodonta strigicollis*) are controlled by two to three sprayings of DDT—Bordeaux mixtures, prepared by mixing 3 lb. of Guesarol 550 in 100 gallons of Bordeaux mixture (5 :5 :50) which is already used against Grape Downy mildew. Care should be taken to use this mixture *immediately* after adding the DDT. (v) Entrap the Cucurbit fruit flies (*Chaetodacus* spp.) in Clensel traps, wherein Clensel is diluted with 30 parts of water. (vi) To control *Pyrilla* on sugarcane, use the dust 5% BHC (either Gammexane or Hexyclan) or 0.3% DDT spray (Guesarol 550; 6 lb. in 100 gallons of water). (vii) For fruit flies on mangoes, guava, destroy fallen fruits and spray *only the foliage* (on sunny sides) of ten different trees (per acre) with a (poisonous) spray of 1 ounce Tartar emetic, 24 ounces of jaggery in 20 lb. of water. This mixture should suffice for *two* acres.

Mid-June to mid-September.

(i) During June-July give two or three dustings (at intervals of twenty days) of 5% DDT (Guesarol 405) against Jowar Stemborer (*Chilo zonellus*) and the Jowar Armyworm (*Cirphis unipuncta*). Care should be taken to dust the seedlings when only 6-8 inches high and dust should be directed to the central whorl of leaves. (ii) With three to four spraying of 0.2% DDT-water suspension (Guesarol 550) at intervals of 20 days, keep under control, Anar Butterfly (*Virachola isocrates*), Mango Shootborer (*Chlumetia transversa*) on mango seedlings and gratts, and 0.15% DDT-water suspension or 5% DDT dust (Guesarol 405) would control Castor Semi-looper (*Achaea janata*), Mustard Sawny grubs (*Athalia proxima*) and Diamond-backed Moth (*Plutella maculipennis*) on cabbage, cauliflower, knolkohl, radish seedlings in nursery beds or fields as well as Lemon Butterfly caterpillars (*Papilio demoleus*), on citrus plants like oranges, lemons, pomelo etc. (iii) In about first week of July, save your paddy crop (Belgaum District) by giving one or two dustings of 5% BHC (either Gammexane or Hexyclan) against early instar nymphs (on grassy bunds and roadsides) and adults of Paddy Grasshopper (*Hieroglyphus banian* var. *elongata*). (iv) To protect your Jowar crop from the ravages of Deccan Wingless Grasshopper, it is expected that 10% BHC (in the form of Gammexane or Hexyclan) should be able to kill the early instars of nymphs breeding in the grassy bunds and roadsides. Do not leave any patches of undusted crops like groundnut, pulses etc. (v) To control the Katra or Gujarat Hairy Caterpillar (*Amsacta moorei*) on bajri, maize, pulses etc., promising results were obtained by spraying the hedges and later the regular crop fields, with 20% DDT emulsion diluted 100 times. This spray would also kill Satara Hairy Caterpillar, Sann Hemp Hairy Caterpillar (*Utetheisa pulchella*) as well. (vi) With regard to aphids on jowar, groundnut, use 5% BHC dust (Gammexane or Hexyclan) or Pyrodust 1,500, taking care to dust all the parts wherever aphids are found.

(vii) In case of crabs (*Paratelphusa* spp.) in paddy fields, fumigate the burrows (first ascertaining the 'live' burrows) by introducing 1 to 2 teaspoonfuls of Cynogas 'A' dust. It is advisable to use the Cynogas foot pump for the purpose. (viii) Before transplanting paddy seedlings, immerse them (for 5 minutes) in a solution of 0.2% DDT-water suspension (Guesarol 550) thus safeguarding against the attack of 'Kane pests' (*Pachydiplosis oryzae*) and *possibly* against the stemborer (*Schoenobius bipunctifer*). (ix) In places where the Rice Blue Beetle (*Leptispa pygmaea*) and the Hispa Beetle (*Hispa armigera*) are of regular occurrence, it is advisable to cut and destroy the leaf-tips of paddy seedlings before transplantation, then dip in 0.2% DDT-water suspension before planting in fields. Should the infestation occur, once again remove the leaf-tips from the standing crop (after careful examination that as yet the paddy plants have not produced the flag-leaf) and dust the crop with 5% DDT dust (Guesarol 405).

(x) Dust a mixture of 5% DDT dust (Guesarol 405) and Pyrodust 4,000 in proportion of 1 : 1 against the infestation of *Epilachna* beetles on various cucurbits, brinjals, as well as against the Pumpkin Beetles. In some cucurbits, DDT dust has caused scorching, so it is better to try the dust in the first instance on only a few plants, three days after or before the routine irrigations.

(xi) The Betelvine Bug (*Disphinctus maesarum*) in Blassein and elsewhere can be brought under control by the periodical sprayings of tobacco (dhus) decoction (1 lb. in 16 to 20 lbs. water and diluted 8 to 6 times respectively) or spray .25% DDT-water suspension. Care should be taken to allow 4 weeks to elapse before harvesting the leaves. (xii) For jassids (*Empoasca devastens*) on cotton, brinjal and potato, dust 5% DDT (Guesarol 405). Jassids causing hopper-burn in potato can very well be controlled by the 0.15% DDT-water suspension spray.

Mid-September to mid-December.

(i) Beware of the Bihar Hairy Caterpillar (*Diacrisia obliqua*) and Sann Hairy Caterpillar (*Utetheisa pulchella*) which would feed on lowersides of leaves in cluster when young. Spray with 20% DDT emulsion diluted 100 times with water or Pyro-colloid (1 : 500) at intervals of twenty days, till the pest is brought under control. (ii) With two to three spraying of 0.15% DDT-water suspension (Guesarol 550) applied once in three weeks, control Onion Thrips (*Thrips tabaci*), Mustard Sawfly grub, Diamond-backed Moth caterpillars on cabbage, cauliflower etc. (iii) After the October-pruning of grapevines,

spray them with DDT-Bordeaux mixture as stated before, against *Udadya*. (iv) Mixture of 5% DDT dust (Guesarol 405) with Pyrodust 4000 in equal proportions, was found beneficial against flea beetles (*Haltica* sp.) on cruciters in nursery beds. (v) On early infestation of aphids on cabbage, cauliflower, green peas, citrus, cotton etc., give fortnightly dustings of 4% BHC (Gammexane) or Pyrodust 1500 or spray of Pyro-colloid (1 : 800). (vi) Give one or two dustings of 10% DDT mixed with Pyrodust 4000, in proportions of 2 : 1 against the Red Cotton Bug (*Dysdercus cingulatus*) in early instars, so also against Groundnut-pod Bug (*Aphanus sordidus*) in store godowns and thrashing floors.

Mid-December to mid-March.

(i) By the middle of December or when mango inflorescences appear either give a spray of 0.15% DDT-water suspension (Guesarol 550) with equal quantity of wettable sulphur or dust the trees with a mixture of 5% DDT dust (Guesarol 405) and sulphur (300 mesh) in equal proportions, against the Mango-hoppers (*Idiocerus clypealis*, *I. atkinsoni* and *I. niveosparsus*). If the attack persists, repeat till the pest is brought under control. At the most two sprayings or three dustings at fortnightly intervals will be found necessary. Incidentally this will also be found useful against the Lymantrid hairy caterpillar (*Dasychira securis*) and the Mango Shootborers (*Chlumetia transversa*) widely prevalent in Ratnagiri District. Depending on the availability and easy access to water, the dusting or spraying should be adopted, because both the treatments are equally effective. (ii) By spraying 0.2% DDT-water suspension (Guesarol 550) Anar Butterfly (*Virachola isocrates*) on pomegranate fruits and Cotton Spotted Bollworm (*Earias fabae*) on bhendy and at 0.15% DDT strength, Diamond-backed Moth and Mustard Sawfly grubs can be controlled. (iii) Pea Aphis (*Macrosiphum onobrachys*), Cabbage Aphis (*Brevicoryne pseudobrassicae*) and Safflower Aphis (*Macrosiphum jaceae*) can be effectively controlled by two to three sprayings of Pyro-colloid (1 : 800) or 5% BHC or Pyrodust 1500 at weekly intervals till the pest is brought under control. (iv) Severe infestation of Dusky Cotton Bug (*Oxycarenus lactus*) can be checked by one or two thorough dustings on cotton bolls with a mixture of 10% DDT (Guesarol 410) and Pyrodust 4000 in proportions of 2 :1 at fortnightly intervals. Removal of affected and fallen-off bolls reduces the infestation to some extent.

B. Occasional Sporadic Pests

Mid-June to mid-September.

(i) Control the surface grasshoppers (*Epacromia dorsalis* and *Chrotogonus lugubris*) destroying vegetable seedlings in seed-beds, and of cereals and cotton in fields by either dusting 5% BHC (Gammexane), or 0.2% DDT-water suspension. (ii) Protect your cereals against the ravages of swarming caterpillars (*Spodopteria mauritia*) or Armyworms (*Cirphis unipuncta* and *C. loreyi*) by dusting the inner whorl of leaves with 5% DDT dust (Guesarol 405) or spraying Pyro-colloid (1 : 800) against the former.

Mid-September to mid-November.

(i) Whenever there is a sporadic outbreak of Mango Slug Caterpillar (*Parasa lepida*) on mango or citrus, spray either 0.2% DDT-water suspension or spraying DDT emulsion 20%, diluted 100 times in water. (ii) Save the bajri earheads from the devastation by the Blister Beetles (*Zonabris pustulata*) by dusting bajri crop when the inflorescence just comes out of the flag-leaf, with mixture of 5% DDT dust (Guesarol 405) with equal parts of Pyrodust (1500) at fortnightly intervals or spraying 0.15% DDT-water suspension. (iii) For the Painted Bug (*Bagrada picta*) on cabbage, cauliflower etc. two dustings of a mixture containing 10% DDT (Guesarol 410) and Pyrodust 4000, in proportions of 2 : 1 at fortnightly intervals would be found very useful. (iv) Control *Heliothis obsoleta* boring pods of gram, tur and tomato fruits, by 0.15% DDT-water suspension (Guesarol 550). Repeat every fortnight.

C. General Crop Pests Found All the Year Round

(i) Be vigilant against the attack of termites (*Cyclotermes obesus*) and other species on wheat, sugarcane, fruit trees, cotton, etc. In loose sandy loams where termite attacks are of regular occurrence, it is suggested that

sugarcane setts and wheat seeds should be immersed for 10 minutes in 5% DDT-water suspension (Guesarol 550 : 1 lb. in 1 gallon of water), and dried in a cool shady place before planting. For temporary relief, irrigate the crop beds with 3 to 4 lbs. crude oil per acre along with irrigation water, and do not use raw F.Y. manure or groundnut cake as top dressing. (ii) To do away with Mealy Bugs (*Trionymus sacchari*) on sugarcane setts, soak them in 1% coaltar solution for half hour, dry and plant them. (iii) To remove the trouble of Rhinoceros Beetle (*Orcytes rhinoceros*) dispose of decaying, fallen down palm trees and manure heaps. The latter can be sprayed with 0.2% DDT emulsion 20%, diluted 100 times or use 10% DDT dust. (iv) To control the Black-headed Caterpillar (*Nephantis serinopa*) on palm, spray the leaves with 0.4% DDT-water suspension. (v) The troublesome nests of red ants (*Oecophylla smaragdina*) should be broken open and then blown in with Pyrodust 1500 or spray 0.5% DDT-water suspension—the latter has longer residual effect. (iii) With regard to Mango Bark-feeder (*Arbela tetraonis*) in mango, citrus, guava trees, scrape off webbings, ascertain 'live burrow', and then inject with borer solution of two parts of carbon bisulphide, with one part of chloroform and creosote. Even petrol would serve the purpose. Care should be taken as these are inflammable. Likewise, Mango Stem-borer (*Batocera rubra*) can also be brought under control. (iv) Leaf-miners on citrus (*Phyllocnistis citrella*) can be controlled by a stronger dose of nicotine sulphate (1 : 400), so also those on crucifers. One pound of bar-soap may be added to 100 lb. of spray. (vii) Against rats (*Gerbillus* and *Mus* spp., etc.) damaging field crops, launch a regular campaign for the fumigation of rat burrows with Cynogas 'A' dust. Prior to fumigation, close all the burrows with mud on the first day and observe on the second day if there are any live burrows. Fumigate only such live burrows. Besides fumigation, poison baits in the form of pills containing one part of *Antu* or white arsenic in eight parts of cooked bajri flour mixed with pieces of groundnut kernels, may be placed in the rat haunts on the third day after sufficiently prebaiting the rat to come near a non-poisonous bait for the first two days.

Lastly during these days of rationing, preservation of food grains from different insects pests is by far the most important. By periodical sweeping of godowns and disinfecting them with 1% DDT-water suspension (Guesarol 550) dusting the gunny bags superficially with either Geigy 33 or Gammexane 4% (DO 34) would control Rice Weevil (*Sitophilus oryzae*), Red Grain Beetle (*Rhizopertha dominica*), Paddy Moth (*Sitotroga cerealella*) and Pulse Beetles (*Bruchus* spp.) etc. Repeat the dustings as and when needed, once in two months in case of Geigy and once a month for Gammexane.

Before concluding this calendar, a word of caution is deemed necessary for those who would be handling and using these insecticides against various crop pests. The insecticides included in the schedule if properly handled and administered in the exact proportions stated against each of them, are harmless. Yet as a precaution, all leafy vegetables and fruits to be used for human consumption, should be washed in water thoroughly before marketing. The safest course would be not to use these insecticides at least *three to four weeks* prior to harvesting time. In that interval of time the toxic effects of the insecticides should be worn off thus rendering them harmless.

NOTES ON BIRDS OF THE IRRIGATED AREA OF SHWEBO DISTRICT, BURMA

BY

W. L. ROSEVEARE, I.S.E. (Retd.)

PART II

(*Continued from p. 534 of this volume*)

Caprimulgus macrourus. The Burmese Long-tailed Nightjar.

Status.—Heard calling twice in the area, on 24 March 1932 at Satthe, and on 1 July 1932 at Pauktaw. Both these places are on the Yeu Main Canal, near Yeu. On 29 August 1932 also, I saw several birds catching insects over the Mahananda tank, Shwebo, which seemed larger than the common nightjar, and were possibly this species.

Caprimulgus monticolus. Franklin's Nightjar.

Status.—On 7 August 1932 I saw a bird at Yeu, with mottled brown plumage, small white wing-patches and white edges to the tail, which was presumably this species. It was standing in the road, with several black drongos, and hawking insects a few inches above the surface.

Caprimulgus asiaticus. The Common Indian Nightjar.

Voice.—I heard birds calling in every month, except July, December and January, at various times between dusk and dawn. On one occasion, in September, the call was heard after 5 or 6 rainless and almost cloudless days. On the other hand, I once watched a bird calling for a long time on 1 June, at midday during rain. The latter bird and another were perched on the tops of fence posts in Yeu inspection bungalow compound. While calling, the whole bird vibrates from head to tail.

Tyto alba. The Barn Owl.

Status.—Only once observed for certain, when a bird flew across my compound at Shwebo at 6 a.m. on 15 August 1932. Another whitish owl, which was probably this species, was seen in the previous month, also at Shwebo, flying across the road in the headlight beam of a car.

Tyto longimembris. The Grass Owl.

Status.—I saw what was probably this bird three times in the area. Two of the observations were at Kabo, on the R. Mu, on 15 August 1933 and 18 January 1934. On the first occasion a bird settled in a dry paddy field, in the growing paddy, and moved to another one when I walked it up. In size it was similar to a barn owl, had a pronounced white facial disc, no ears, all the upper plumage brown, with white spots on wings, tail white with narrow dark brown bars, lower plumage brownish white, legs dark, eyes very dark. The bird seen on 18 January got up from the river bank and settled again on the ground. In appearance it was similar to the first, but with dark eye-patches and white feathering on the thighs. The third observation was on 27 January at Shwebo, when a bird was seen perched inside the roof of an empty building. I would have taken it for a barn owl, if it had not been for the warm brown of the upper plumage.

Athene brama. The Burmese Spotted Owlet.

Identification.—One young bird which I kept in my house for several days had no white spots on the crown. I noticed this on another occasion in the field (vide **next para**).

Habits.—On 6 June 1932 I saw two birds in a tree, one of which was a young bird with an unspotted crown and the other was in normal plumage. They were rubbing their bills together, scratching each other on the head, and sometimes looking exactly as if whispering in each other's ear. The one with the spotted crown flew off and repeated the performance with another bird, also in normal plumage. A few days later, in another locality, I watched the same display of affection between two birds on the top of a fence post. I once saw two birds clinging to the trunk of a toddy palm, like woodpeckers, and once saw a single bird on a telegraph wire. On another occasion a bird was in a tree close to two pied mynahs and two pied crested cuckoos.

Nesting.—Not observed, but a pair were seen copulating on 3 August.

Status.—Seen in every month. Noted as numerous in November 1932, and 1933 and September 1933, and as uncommon in February 1933 and December 1933.

Ninox scutulata. The Brown Hawk-Owl.

Status.—Two observations, one in small scrub near Shwebo, and the other in the Mu river bed at Yeu. Identified in both cases by the long pointed wings and the owl-like head.

Pandion haliaëtus. The Osprey.

Status.—Two good observations in the area, on 26 September 1933 and 23 October 1933, and two doubtful ones, on 24 July 1932 and 13 September 1932. On 26 September two birds were seen perched close to the Mahananda tank, Shwebo, while on 23 October three birds were seen fishing in the tank. The bird seen on 24 July, which hovered and dropped like a kestrel and was probably this species, flew off a nest 20 ft. up in a small *tanaungbin* tree on the shore of the Mahananda, pursued by a number of small birds. The nest which was empty, was a large one made of sticks, straw and rags, with a shallow cup.

Sarcogyps calvus. The Black Vulture.

Habits.—I saw a bird once at a carcass in company with a long-billed and a white-backed vulture.

Nesting.—A bird was seen on 15 October on top of a bare tree alongside a nest of grass and small sticks.

Status.—Recorded in every month except March and May. Rather uncommon.

Gyps indicus. The Long-billed Vulture.

Habits.—Nearly always seen in company with long-billed vultures.

Status.—Recorded in every month except May and December. Not very common.

pseudogyps bengalensis. The Indian White-backed Vulture.

Habits.—Nearly always seen in company with long-billed vultures.

Status.—Recorded in every month from June to February except December, but never very common. Not seen between 28 February and 10 June.

Falco peregrinus. The Eastern Peregrine and Shahin Falcons.

Status.—One observation only, on 30 November 1932, when a bird, unmistakably this species, got up from the nearly dry bed of the Yeu canal and settled in a bare tree.

Falco jugger. The Laggar Falcon.

Status.—Four observations, all between 7 August and 4 October.

Falco tinnunculus. The European and Himalayan Kestrels.

Status.—A single male seen in flight on 18 March 1933 near Yonzu, Shwebo canal area. I think I saw another one on 23 September 1932 along the Old Mu canal.

(?) **Neohierax insignis.** Fielden's Hawk.

Status.—One doubtful observation, on 16 September 1933. A single bird probably this species, was flying from bush to bush in scrub jungle near Shwebo town.

(?) **Erythropus amurensis.** The Eastern Red-legged Falcon.

Status.—One doubtful observation, on 19 November 1932, when a bird, thought to be a female or young male of this species, was seen on the outskirts of Shwebo.

Aquila clanga. The Greater Spotted Eagle.

Identification.—The white on the upper tail-coverts was usually very conspicuous. No birds without this marking were identified.

Habits.—I found this bird fond of standing on the smooth inspection paths of canal banks. It was always very bold and usually stood its ground until closely approached, when it would fly up reluctantly into a tree. It was sometimes seen singly, but more often in pairs or in small parties.

Status.—Clearly identified 8 times in the area. Earliest date 3 October, latest 21 March.

Hieraëtus fasciatus. Bonelli's Eagle.

Identification.—The bill sometimes appeared almost white, rather than bluish-grey as in F.B.I.

Habits.—It has the flycatcher's habit of returning again and again, after short flights, to its starting point, whether on the ground, or in a cotton tree, toddy palm or other tree. When perched, it holds itself very erect, and in flight the use of the tail as a rudder is very noticeable, as in the case of the pariah kite. One bird, on my approach dropped a pond heron which it was carrying.

Status.—Identified 8 times in the area. Earliest date 21 September, latest 3 April. I found no nest in the area, but two birds were seen in the same tree at Taze on 26 and again on 27 November 1932, and I suspect that they were going to breed there.

Hieraëtus pennatus. The Booted Eagle.

Status.—I twice saw single birds, on 6 March 1931 and 9 October 1933, which were apparently this species, not Bonelli's Eagle. They were no bigger, if as big, as a Pariah kite, were much speckled or splashed with white on the upper plumage, and one at least had white thigh-coverts. The use of the tail as a rudder was conspicuous in one case.

Spizaëtus cirrhatus. The Changeable Hawk-Eagle.

Status.—Only two doubtful observations, both of the melanistic form.

Spilornis cheela. The Crested Serpent Eagle.

Identification.—When the neck feathers are ruffled by wind, a white collar shows conspicuously. The white band on the tail and the white tip to it are also conspicuous.

Habits.—Its contempt of man is very striking. I have seen it, perched very erectly, on the ground, on a post, on a dead bough and in trees.

Status.—Six observations, mostly in March or April, but also in August and October.

Butastur teesa. The White-eyed Buzzard-Eagle.

Identification.—I frequently found the grey wing patches more conspicuous than the white nape patch. There was sometimes no sign of white in the eyes.

Habits.—I only once or twice saw two or more birds together. Other birds seem to ignore its presence. I once saw several sparrows perched a yard or two from it on telegraph wires, and on another occasion two house crows within two feet of it on a tree.

Nesting.—The only nest seen was on 31 March 1932 on the outskirts of Shwebo, 50 ft. up in a bare tree, at the end of a small branch. It was loosely made of sticks only, and contained 3 eggs.

Status.—Usually fairly common, but never observed between 31 March and 30 May or between 4 September and 16 November.

Butastur liventer. The Rufous-winged Buzzard-Eagle.

Status.—Only identified once, on 29 October 1933, along the Old Mu canal near Kinu, when a single bird was perched on a bush.

Haliastur indus. The Common Brahminy Kite.

Habits.—Sometimes very bold. I once came upon a crowd of storks, egrets and herons of various species, a common sandpiper and a common kingfisher, with a Brahminy kite, at a small pool. When I stopped, they all flew off except the Brahminy which held its ground. I saw it fairly frequently on the ground, and one September I saw a party of 6 adults in that position. Once, on 13 January, I saw a pair fighting in the air with a pair of Pariah kites. The latter repeatedly settled in a tree, but on the Brahminys attacking them, gave battle again.

Nesting.—Birds seen pairing off on 3 January. Nests seen under construction on 28 January, and 26 February. The former was in a *tanaungbin,* and the latter in a fork near the top of a tall tree.

Milvus migrans. The Common Pariah Kite.

Status.—Fairly common: birds seen several times in June, the latest date being 22 June. Earliest date of return 22 September.

Elanus caeruleus. The Black-winged Kite.

Status.—Observed 4 times in the area, all between 3 September and 17 March. On all four occasions a single bird was hovering over paddyfields.

Circus melanoleucus. The Pied Harrier.

Habits.—Once, on Maymyo golf course, I saw a male hovering motionless a foot or two above the ground. In the Shwebo area, I once saw a bird soaring about 400 ft. up, and I twice saw birds standing in the shallow water of canals.

Status.—Earliest date 10 September, latest 14 March. Fairly common.

Circus aeruginosus. The Common Marsh Harrier.

Identification.—I found the easiest way to distinguish the female from that of the pied harrier in the field was by the absence of white on the upper tail-coverts.

Status.—Earliest date 2 October. Observed several times in April, the latest being 25 April. Fairly common between those dates.

Buteo rufinus. The Long-legged Buzzard.

Status.—On 8 September 1932, near Nyaunghla, a bird settled in a toddy palm. It was the size of a Brahminy kite or larger. The bill was very hooked and the thighs feathered. The upper plumage was dark streaky brown with a few white streaks also. The rump or upper tail-coverts were yellowish white, the lower plumage whitish and the thigh coverts white. From the appearance and behaviour it was probably this species.

Buteo burmanicus. The Japanese Desert Buzzard.

Status.—Identified twice in the area. The first occasion was on 13 February 1932, near Yeu, when a bird was seen drinking at the river's edge. The shape and size (that of a Pariah kite or perhaps smaller), the feathered tarsus, light grey face, dark brown tail, and dark bill and eye appear to identify it as this species. The second bird was first seen soaring over the Shwebo canal at Myittaw on 27 November 1933. Later I saw it perched in a tree and swooping

down to the canal for offal. It allowed a very close approach, and I recorded the following:

Size of Brahminy kite or smaller. Tail slightly rounded. Wings long. Tibia feathered, tarsus bare. Crown, nape and sides of head light brown, ear-coverts darker. Upper plumage all dark brown, with whitish edges to feathers. Flight feathers and tail blackish. Throat streaky brown, with reddish tinge. Breast brown. Patches under wings conspicuously white. Eye dark. Bill all grey, cere white. Legs dull yellow, claws grey.

Accipiter badius. The Shikra.

Habits.—Observed a number of times on the ground, once at the water's edge in a canal bed.

Status.—Seen throughout the year, but never common.

Accipiter nisus. The Asiatic and Indian Sparrow Hawks.

Status.—Only seen once, on 28 September 1933, when a single bird was flying from tree to tree at the edge of the Paiktaw *in* near Shwebo. Distinguished from the Shikra of all ages by broad wings, brown upper plumage and barred breast. Shortly after, at the same place, either the same bird or another one fluttered from a *kazin* into a wet field and back. The latter bird, at any rate, was a young one. White abdomen and thighs were noticed.

Accipiter virgatus. The Northern Besra Sparrow Hawk.

Status.—Only one observation, on 15 November 1933, at Thayetkyi, when a young bird settled in a cotton tree in the bungalow compound. It was the size and shape of a Shikra, with fairly long pointed wings, but distinguished from that bird by the strongly marked light and dark brown bars on upper plumage and broad black streaks on white underparts.

Crocopus phoenicopterus. The Green Pigeon.

Status.—Only four good observations and one doubtful one, in January, July, August and November. In one case about 8 birds were perched very conspicuously on top of a bare tree. In another, 4 birds were feeding on berries in low bushes.

Streptopelia chinensis. The Spotted Dove.

Habits.—On 22 April 1933 innumerable birds were standing, with many ring doves, on the Shwebo-Kyaukmyaung Road for a distance of several miles. I never saw them so plentiful on any other occasion. They are very brave when with young. One bird of a pair once flew out of a bush within two or three yards of me, and the other one off the nest when I got still closer.

Nesting.—Of two nests seen in the Mandalay district, one was in a hut in a paddyfield, and the other in the fork of a small tree just above a Blandford bulbul's. Of four seen in the Shwebo area, all were in bushes or small trees between 4 ft. and 6 ft. above ground. One of these 6 nests contained 2 young, the sitting bird was not disturbed off another. The remaining 4 only contained one egg or one young bird.

Status.—Very common in every month, perhaps rather less so during the rains.

Streptopelia decaocto. The Ring Dove.

Habits.—I have many notes of this bird in the area, but always singly or in pairs, never in a flock. I once saw one with a party of red turtle doves, and on 22 April 1933 I saw large numbers with spotted doves (q.v.).

Status.—Observed in every month. Fairly common.

Œnopopelia tranquebarica. The Red Turtle Dove.

Habits.—Nearly all my notes are of birds in trees. I seldom saw them on the ground. In May 1928 large flocks were seen roosting in thick-foliaged trees in Fort Dufferin, Mandalay, and were very timid. On 28 October 1930 two

pairs were flying round the ship on which I was travelling near the China Bakir light-ship at the mouth of the Irrawaddy. One male settled on the ship, another bird several times descended close to the water and once touched it.

Status.—Never seen at all in the area between 5 May and 27 July, and never seen in flocks between 16 April and 16 September. Common during the rest of the year.

Gallus gallus. The Jungle Fowl.

Status.—Seen only once in the irrigated area, on the Old Mu canal at Kinu on 28 October. A female was seen near Kyaukmyaung, on the Irrawaddy, on 20 November, and two separate pairs on the Shwebo-Kyaukmyaung road on 22 April.

Coturnix coromandelica. The Black-breasted Quail.

Voice.—A bird I watched calling in September was standing very erect and jerking the whole head and breast violently. From the break of the monsoon up to the end of August, I seldom heard one calling. One night in October, a bird was calling an hour before sunrise.

Habits.—Twice in the hot weather parties of birds—2 or 3 in one case, 5 in the other—got up at my feet.

Status.—Fairly common throughout the year. No records in January, May or November. On 8 June 1933 birds were numerous on recently flooded land alongside R. Mu at Kabo. On 10 September, 1933 numerous birds were calling at the edge of the Kadu lake.

Arborophila atrogularis. The White-cheeked Hill Partridge.

Status.—On 9 April 1932 a strange partridge, the size of a francolin, got up at my feet near the head of the Yeu canal. The general colour was yellowish brown, with a grey tinge on the wings, which seems to accord best with this species.

Francolinus pintadeanus. Phayre's Burmese Francolin.

Voice.—Once in April I heard two birds calling to each other sometime after dark. On another occasion, in September, I saw a bird, which had been calling, fly out from 20 ft. up in a tree. I have no record of birds calling in January, February, July or December, but they were heard in all other months including several birds on one very oppressive evening in April.

Habits.—Several times in the cold weather I found birds very tame, walking slowly off the road into the jungle as I passed in a car.

Status.—Heard or seen in every month except December, usually on the outskirts of the irrigated area.

Amaurornis fuscus. The Ruddy Crake.

Status.—Only observed once, on 30 April 1933 in the bed of the Mahananda tank, Shwebo, when a single bird was hunting for food among dead leaves on swampy ground. I had a very good view and recorded a detailed description, which leaves no doubt of the species.

Amaurornis phoenicurus. The Chinese White-breasted Waterhen.

Status.—Observed throughout the year, but not common.

Gallinula chloropus. The Indian Moorhen.

Status.—Uncommon in the area. Seen five times between December and April on the Mahananda tank, Shwebo, and once, on 9 October, on the Wetlet lake. On 6 February, 1932 a party of about 15 was swimming on the Mahananda tank, and a young bird was seen there on 20 December 1932.

Gallicrex cinerea. The Watercock.

Identification.—I never saw a bird with a red bill, but have 6 records from the area during the rains of birds with yellow bills and red shields. The yellow bill was on one occasion very conspicuous through glasses at a distance of $\frac{1}{4}$ mile or more.

Voice.—The call which I heard most often was like water pouring out of a narrow-necked bottle, preceded sometimes by a peculiar growl, like the noise of an aeroplane in the distance. Another common call was rather like the popping of corks, which it made by bending the neck forward, opening the bill and working the throat.

Habits.—Mostly seen in paddyfields, either in growing paddy or in long grass.

Status.—Quite common from May to September, especially in August, and September. Once heard calling (the call is unmistakable) on 27 November, and once on 19 January, otherwise not heard or seen between 14 September and 15 May.

Porphyrio poliocephalus. The Indian Purple Moorhen.

Status.—Only seen on the Mahananda tank and the Wetlet lake. On the former it was only seen three times, a single bird on the 26 June 1931, a number of birds on 15 July of the same year, and two birds on 7 November 1932. On 1 September 1933, a thorough search revealed no birds, and it appears to be only an occasional visitor to this tank. On the Wetlet lake, a single bird was seen on 2 July 1933, there were apparently no birds there on 7 September or on 9 or 10 October of the same year, but on the 9th of the following month a party of 6 or 8 birds was feeding on the lake. In December 1932, a flock of about 15 was feeding there, and in January 1933 and January 1934 there were large numbers of birds. It is apparently therefore a local migrant.

Fulica atra. The Coot.

Status.—Not seen anywhere between 30 April and 11 October, and at other times seen only on the Mahananda tank and Wetlet lake. On the Mahananda tank it was definitely absent on 1 September 1933, single birds or pairs were seen between 11 October and 20 December 1932, numbers of birds on 12 February 1933, and single birds on 27 March and 30 April 1933. It was absent from the Wetlet lake on 7 September 1933 and again on 9 and 10 October. In the cold weather of 1932-33 and 1933-34 flocks of hundreds were always on the water from 8 November onwards.

Metopidius indicus. The Bronze-winged Jacana.

Habits.—I have seen it more than once wading in the water, though it usually walks on the lily leaves. It was often seen associating with the pheasant-tailed species.

Status.—Seen on the Mahananda tank in every month of the year, but never on the Wetlet lake. From December to June, considerable numbers were always present on the Mahananda tank, but for the rest of the year never more than one or two. Nesting was once suspected, but no nest ever found. On 20 December 1932 numbers of adults were feeding, but only one young bird. A single young bird was seen there on 26 April 1933.

Hydrophasianus chirurgus. The Pheasant-tailed Jacana.

Status.—Except for one doubtful observation on a smaller tank, this bird too was only seen on the Mahananda tank, and never on the Wetlet lake. In every month between 8 December and 14 June it was in considerable numbers, in other months only single birds or pairs were seen. Full breeding plumage was observed on 26 April, and the remains of it on 7 November. No nest was found.

Rostratula benghalensis. The Painted Snipe.

Status.—Only one observation, a pair being seen at the Mahananda tank on 21 May 1933. They frequently raised their wings above their backs, lowered their heads, and ran at Jerdon's mynahs which came too close.

Antigone antigone. The Sarus Crane.

Status.—I myself only saw the bird once in the area, when a single bird was with three adjutant storks in the reeds of the Kadu lake on 11 August

1933. It flew right away with them, keeping right alongside one of them all the time, as if it were its mate. I had a close view with glasses and the identity was unmistakable. On 17 February 1931 my wife saw two birds get up from the bed of the Yeu canal, which I am satisfied from her description were this species.

Burhinus oedicnemus. The Indian Stone Plover.

Voice.—The loud plaintive whistle was quite a common sound in the area, sometimes during the day but more often during the hour or two after sunset. I knew the sound well for a year or more before I connected it with this bird, which I much more often heard than saw.

Habits.—I once watched a bird stand quite motionless for more than ten minutes, except for once leaning its head sideways and occasionally flicking its tail. I got tired of the game and moved first; I saw one bird get up from a wet paddyfield, but all others were in thin scrub jungle.

Status.—Fairly common. Heard or seen in most months, but not between 25 June and 12 September, or between 28 October and 23 January.

Esacus recurvirostris. The Great Stone Plover.

Identification.—Several times when in flight, I noted a strong resemblance to ducks. In fact, on at least one occasion I at first mistook a flock for a flock of duck.

Habits.—Once or twice I saw the bird running with a curious crouching gait, with the 'knees' bent. As I approached a bird one day in April, it ran ahead, squatting at intervals, before eventually taking to flight.

Status.—Seen only 6 times, all in the Mu river bed between 18 January and 24 August.

Glareola maldivarum. The Large Indian Pratincole.

Voice.—I once saw a bird uttering a call something like a greenshank's.

Habits.—A party I saw on 31 August 1932 were lying very low on the ground. On 3 August 1932 a single bird was standing motionless on a mud-bank, at intervals flying round in circles for a few seconds and returning to the same place. Seen mostly at the Mahananda tank and at or near the Wetlet lake, but one day in April 1933 I three times saw single birds standing on the bank of a distributary canal near Shwebo, which was carrying a little water.

Status.—Seen in every month from March to September, except May, but never common. Earliest 27 March, latest 3 September.

Glareola lactea. The Small Indian Pratincole.

Habits.—A flock of 40, which I saw on Wetlet lake in December, 1933, were very tame, standing and sitting about very sluggishly with drooping wings. One scraped a hole in the mud and sat in it. I twice saw birds in the cold weather at Wetlet lake, otherwise only in the bed of the Mu. On 8 May one year I saw two birds alone and two or three times in the rains parties of not more than 5.

Nesting.—A large flock in the Mu river bed at Yeu on 22 April 1932 was evidently, from the birds' behaviour, a breeding colony though I saw no eggs. On 5 May 1933 I saw eggs and young in the river bed at Kabo. Young birds, about 4" long, were running about surprisingly fast with their parents. Two eggs were on top of a small sand hillock, which was quite bare, in preference to neighbouring ones which all had a little vegetation.

Status.—Seen in all months except February, June, October and November. Not seen between 6 September and 16 December.

Larus brunnicephalus. The Brown-headed Gull.

Only seen twice, on 23 January, 1934, when a single bird was standing on a *kazin* in Wetlet lake with some whiskered terns, and on 5 February 1934 when two birds were with a party of pheasant-tailed jacanas on the Mahananda tank.

Chlidonias hybrida. The Whiskered Tern or? **Chlidonias leucoptera.** The White-winged Black Tern.

Identification.—The bill and legs sometimes appeared black in the field. Probably these birds were white-winged black terns. I once saw the grey under parts of breeding plumage as late as 18 December.

Voice.—Once, on 9 November, I saw a bird screaming rather like a gull.

Habits.—I once saw one bird of a flock hawking flying insects. On 8 November 1933 a flock of 50 or 60 was beating up Wetlet lake very slowly against the breeze, only twelve inches above the water—a most beautiful sight.

Status.—Only seen on the Mahananda tank and Wetlet lake. Earliest date 9 October, latest 12 February. Fairly common.

Sterna aurantia. The Indian River Tern.

Identification.—A large flock seen on 10 November all had the black crowns of breeding plumage. They were with black-bellied terns in non-breeding plumage, and clearly distinguishable. Many birds seen on 3 January all had black crowns. On 10 January, one of several was in process of losing the black crown, the others being still in full breeding plumage.

Habits.—I have seen it hovering over the water like a pied kingfisher, with the bill pointing downwards like that bird's, but not plunging quite so vertically.

Seen on Wetlet lake several times in the cold weather, usually solitary, but once, on 10 November, in a large mixed flock with black-bellied and other terns. Only once on the Mahananda tank, two birds on 26 April. Frequently seen along canals in the cold weather; once a flock of about 30 fishing in a shallow pool. Elsewhere only seen on the Mu river.

Status.—Not seen between 10 June and 9 November, and curiously irregular in their occurrence at other times. For instance, I never saw a bird in February and only an occasional single bird or pair in April; yet on 15 March 1933 there were numbers of them on the Mu at Kabo. Again, on 3 January 1933 many birds were seen in the Yeu canal area, yet on the 22nd of the same month only one solitary bird was seen during a whole day on Wetlet lake, where a large flock was seen the following November.

Sterna melanogaster. The Black-bellied Tern.

Identification.—On 5 May 1933, among several birds still in full breeding plumage, there was one with only a small black patch on the abdomen, and another with no sign of black on the lower plumage, though both still had the black crowns. A bird seen on 8 June still had the black belly. Of several birds seen on 10 November, all had black crowns but some had white bellies. A bird seen on 16 December, with others in breeding plumage, had dark grey crown and white belly. It appears that the black crown is retained later than the black belly, but resumed earlier.

Nesting.—A nest with one nestling and one egg was found in the Mu river bed at Yeu on 13 April 1932. A bird, much excited, swooped within a few inches of my head at Kabo on 5 May 1933, though it was with several others, of whom two were losing their breeding plumage.

Status.—Not seen between 8 June and 13 October. Common in other months, especially March to May, on the Mu river, Wetlet lake and along canals.

Sterna albifrons. The River Ternlet.

Status.—Only seen once in the area, on 20 July 1932, when a single bird settled at the edge of the water in the Mahananda tank, Shwebo.

Rhynchops albicollis. The Indian Skimmer.

Status.—Two observations only, both at Kabo, one of four birds fishing on 10 June 1933, the other of three birds on 31 January 1934.

Leucopolius alexandrinus. The Kentish Plover.

Status.—On 10 November and 16 December 1933 on Wetlet lake and on 7 January 1934 on the Mahananda tank, I saw flocks feeding which were either this species or young little ringed plovers. As in each case there was

not a single adult little ringed plover among them, they were probably Kentish plovers.

Charadrius dubius. Jerdon's Little Ringed Plover.

Habits.—I once saw a bird in shallow water, feeding among reeds, and once a number of birds in a nursery paddyfield; otherwise they were always on sand or mud in canal or river beds, swamps or *ins.*

Status.—Observed in every month; common, though less so in the cold weather. No nest found in this area.

Charadrius dominicus. The Asiatic Golden Plover.

Status.—Seen only on the Wetlet lake, in November and December. Always seen feeding on the mud in flocks of up to 25 in company with sandpipers and, on one occasion, Kentish plovers. The white forehead and supercilium of breeding plumage was still visible on 10 November.

Vanellus vanellus. The Lapwing or Green Plover.

Status.—Only seen once in the area, on 7 January 1934, when three birds were in shallow water in the Mahananda tank, Shwebo, among a flock of grey-headed lapwings. I had a very good view of them and they were unmistakable.

Hoplopterus duvaucelli. The Spur-winged Plover.

Habits.—I used to see them in the Mu river bed and at and near the Mahananda tank, but not at the Wetlet lake or elsewhere. At the Mahananda tank they were commoner in the cold weather than at other seasons. In fact, a bird I saw there on 19 November 1933 was the first I had seen away from the river for months, probably since the start of the rains.

A distinctive habit is to stand motionless for long periods at a time, even in the cold weather and when in flocks. One which I timed stood motionless for more than 6 minutes. I once saw one feeding in an inch or two of water.

On 7 January 1934 two birds of a party of 7 were running about close together, sometimes stopping and bowing continually in all directions—presumably courting though it seemed rather early.

Nesting.—None found, but judging from the behaviour of a pair in the Mu river bed on 8 May 1931, they had young. At Kabo on 15 March 1933 there were a number of birds, both in pairs and in parties. While unaware of me they did nothing but feed, but when I was observed some of them behaved as if to decoy me from young.

Status.—Observed in every month, but their movements were very irregular. I have seen considerable numbers on occasions in March, July, August and November, but sometimes they were very scarce for months together.

Lobivanellus indicus. The Red-wattled Lapwing.

Voice.—I have heard birds calling an hour before sunrise and well after sunset. I have also seen them calling occasionally while running as well as in flight.

Nesting.—A nest found near Shwebo on 22 June 1933 was on a small mound in a wet field, the depression being lined, not encircled, with dry chips of wood and small pieces of dry mud. The birds sat and kept guard by turns. They were very timid, being frightened even by a solitary dog at a distance. I took one of the four eggs, and the bird was very restless before settling down again. Four days later the three remaining eggs had been re-arranged symmetrically. Both birds were wildly excited. When I replaced the fourth egg, one bird soon returned and settled again without re-arranging them. On 11 July the nest was empty, even the egg which I had removed for four days being missing. On 13 July 1932 several birds at Shwebo Cantonment were diving excitedly at my dog, as if they had young.

Status.—Common all over the area in every month. I have also seen the bird at Lashio and at Bernardmyo (5,500 ft.), Northern Shan States.

Microsarcops cinereus. The Grey-headed Lapwing.

Habits.—Only observed on the Wetlet lake and the Mahananda tank. I have seen flocks of 21 and 24 birds, but apart from those always saw them singly, in pairs or in parties of up to 7 or 8. I saw them more than once standing in shallow water.

Status.—Earliest date 2 October, latest 27 March. Observed in every month between those dates.

Himantopus himantopus. The Black-winged Stilt.

Habits.—I saw them more than once mixed up with flocks of ducks, and once saw a flock of about 20 flying in V-formation.

Nesting.—No nests found, and the reported breeding site at Kinu[1] held no birds on either 30 July 1932 or 13 August 1932. On 3 April 1931, however, I saw a pair copulating in the shallow water of the Mahananda tank.

Status.—Seen twice in paddyfields and once in a drainage channel: otherwise only at the Mahananda tank and Wetlet lake. Observed in every month except February, but their movements were very irregular. Between 8 May and 30 July 1932 a flock of up to 120 was seen several times in the Mahananda tank, but was not always there. In 1933 there were numbers of birds there in April and May, but none from then up to the end of October, although the depth of water was sometimes suitable. On the Wetlet lake there were large flocks on 3 September 1932, but definitely no birds on 2 October, although the depth of water was suitable. There were a few birds on 11 December, and large numbers on 22 January 1933. On 7 September 1933, on the other hand, there were very few birds there, but on 10 October and again on 8 November there were hundreds. A partial explanation may be afforded by the fact that in early September 1933 the water was deeper than at the same time in 1932.

Limosa limosa. The Eastern Black-tailed Godwit.

Status.—On 3 September 1932 I saw a flock of about 15 birds flying very fast over Wetlet lake, which were apparently this species. They were the size and shape of greenshanks, plumage mainly drab like a common sandpiper's, white bar on wing, tail white with dark tip. I knew the redshank well and am sure that they could not have been that species.

Tringa ochropus. The Green Sandpiper.

Status.—Only three good identifications, all at the Mahananda tank, in two of which it was in company with common sandpipers, when the larger size was noticeable. Two of the observations were in February, and the third on the 28 March. A solitary sandpiper was once seen at the same place on 15 July, which was probably this species, but may have been a wood sandpiper.

Tringa stagnatilis. The Marsh Sandpiper.

Status.—Only seen once, in the Wetlet lake on 28 January 1934—a single bird in shallow water. The resemblance to a miniature greenshank was striking.

Actitis hypoleucos. The Common Sandpiper.

Habits.—Though usually solitary, I once saw a flock of 27 at the Mahananda tank on 1 September, first flying about high up and later feeding at the water's edge. They were very wild.

Seen occasionally in company with green sandpipers, and on other occasions with wood sandpipers. On 27 April 1933, at the Mahananda tank, there were any number of birds feeding with wood sandpipers in one or two inches of water—unusual behaviour.

I once saw a bird feeding on floating rubbish in the Mu river, which had lost all the toes from its left foot, but was walking about without even limping.

Status.—Earliest date 24 July, latest 14 May. Common in all months from August to April, but noted as especially so from September to November and

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[1] Vide Birds of Burma—Smythies.

again in April. On 8 November 1933 I noted that birds had been numerous recently in the area, yet on that and the two following days not a single one was seen at Wetlet lake, where they had been numerous on the preceding 9 October. Again on 29 January 1934 no birds were seen in several hours at Wetlet lake, though wood sandpipers were numerous.

Tringa glareola. The wood Sandpiper.

Status.—Common throughout the area in every month from August to April, especially from December onwards. Earliest date 20 July (two birds), latest 27 April (numbers of birds, with white spots on wings unusually conspicuous).

Tringa totanus. The Tibetan and Central Asian Redshanks.

Habits.—As often as not I saw this bird along canals, wet borrow-pits being especially attractive to it. In February 1933 I saw as many as 50 birds in a single small borrow-pit, and on Wetlet lake in December have seen flocks of 100 or more.

Status.—Earliest date 31 August (two birds in Mahananda tank) but, as no other birds were seen before 10 November, these were possibly residents. Latest date 26 February. On 10 November 1933 only two birds seen during three days on Wetlet lake, but by the following 16 December there were large flocks there.

Tringa erythropus. The Spotted Redshank.

Status.—I twice saw single birds which appeared to be this species. The first one, on 24 February 1932, was at the water's edge in a canal borrow-pit. It appeared as big as a greenshank and uttered a loud clucking noise, not unlike a domestic hen's, and occasionally a shrill whistle *pee-wit*, both calls being uttered both on the ground and on the wing. In the second case, on 23 January 1933, the bird was in a pool in a canal bed, the upper plumage being light brownish grey with white spots.

Tringa nebularia. The Greenshank.

Local name: *Ngon-gya.*

Identification.—A bird seen on 10 April 1932 was in process of acquiring breeding plumage.

Habits.—Frequented the beds of canals in the cold weather, when only a little water was running. Usually seen singly or in pairs, but I once saw a party of 7 in flight in October. One November at Kabo, I watched three birds running about in formation at the edge of the river, with their bills lowered right to the ground, presumably chasing insects.

Status.—I saw a single unmistakable bird at Kaoo on 5 July 1933, presumably a non-breeding resident. Otherwise, the extreme dates were 11 September, and 5 May. Common from November to February, though in three days on the Wetlet lake in early November 1933 I did not see a single bird. It seemed to prefer the river bed and canals to jheels. I have no record of one on the Mahananda tank.

Calidris temminckii. Temminck's Stint.

Habits.—Seen more than once in company with little ringed plovers, and once with wood sandpipers I once saw a bird perched a few inches above the ground, preening its feathers.

Status.—Only seen at the Mahananda tank and the Wetlet lake, and not common even there. Apart from one bird, possibly a non-breeding resident, seen feeding at the Mahananda on 20 July 1932, the earliest date was 10 November and the latest 27 April.

Limicola falcinellus. The Eastern Broad-billed Sandpiper.

Status.—A number of birds were seen at the Mahananda tank on 26 April 1932, feeding in the mud with little ringed plovers, which were probably this species on passage. The head, neck, upper back and breast were drab grey, with a darker line on the crown and pale supercilium. The wing-coverts were dark reddish-brown, mottled lighter, abdomen and vent white, and bill very dark. Evidently they were acquiring breeding plumage.

Capella gallinago. Fantail Snipe.

Capella stenura. Pintail Snipe.

Habits.—I several times saw one or other of these feeding in shallow water. One which was doing so squatted in the water on my approach.

Status.—I was never able to distinguish the two in the field. One or both was fairly common in the area from September to April, though on 27 March 1933 there was not a single bird to be found at the Mahananda tank. Earliest date 5 September, latest 27 April.

Pelecanus philippensis. The Spotted-billed Pelican.

Status.—For a few days in July 1932 a single bird visited the Mahananda tank; otherwise I only saw it on the Wetlet lake. A single bird was there on 2 July 1933, three single birds on 7 September, and a single bird on 10 October. From 8 to 10 November there were no birds there, but on 29 January 1934 there was again a single bird.

(?) **Phalacrocorax carbo.** The Indian Large Cormorant.

Status.—On 22 April 1933 I saw two cormorants or shags flying down the Irrawaddy at Kyaukmyaung, which were larger than little cormorants. As shags are said to be confined to the coast, they were probably this species.

Phalacrocorax javanicus. The Little Cormorant.

Habits.—Usually seen perched on posts or sticks, but on 6 April 1932, and again on the 8th, I saw many birds near Kabo perched on the tops of tall trees, mostly bare ones.

Status.—Observed in every month, both on jheels and canals, but much more common in most of the area during the hot weather than in other seasons. On Wetlet lake, however, I found them numerous in October and November 1933 also. They appear to move about locally a good deal, as birds were very numerous on the Mahananda tank on 26 April 1933 and again on 14 May that year, yet on 30 April there were very few there.

Anhinga melanogaster. The Indian Darter.

Habits.—One bird I watched one January was twisting its neck about, with its bill open, producing no noise but a curious vibration just below the skin. On two occasions I found them numerous on the Wetlet lake, and sometimes saw them in pairs or in parties of a few birds, but as a rule they were seen singly.

I have seen them in the dry weather perched over canals or patches of swamp, with the depth of water insufficient for diving or even for swimming.

Status.—Observed in every month from December (from the 1st) to May (up to the 31st), but only seen once during the rest of the year, when two birds were flying over the Wetlet lake on 4 September. Although birds were numerous on the lake in December 1932 and January 1933, there were none there on 9 October or on 8 to 10 November 1933. Apparently a local migrant.

Threskiornis melanocephalus. The White Ibis.

Status.—On 14 June 1933 I saw what appeared to be two young birds of this species among about 100 openbills wheeling over the Shwebo canal about 200 ft. up. Otherwise only seen between 2 October (1932) and 22 January, and only on the Wetlet lake. On 9 and 10 October 1933, however, the whole of the lake was covered and no birds found. They were usually in company with considerably larger numbers of openbills, and on 9 November 1933 there was a mixed flock of several hundreds, with the openbills predominating. Later the same day I saw a flock of about 100 white ibis in flight by themselves.

Plegadis falcinellus. The Glossy Ibis.

Local name: *Hka-yu-sok-anet.*

Voice.—Some birds which I put up in November uttered a call in flight rather like the *mew* of a ring dove.

Habits.—In early September I found them very wild. I have seen them feeding close to a flock of white ibis and openbills and in company with

egrets. Occasionally seen singly or in parties of three or four, but usually in flocks of about 40, and once in January in a flock of several hundreds.

Status.—Only seen on the Wetlet lake, where they were usually in considerable numbers from September to January. Earliest date 4 September, latest 22 January.

Ciconia nigra. The Black Stork.

Local name: *Chi-gyin-sut.*

Habits: Usually seen along canals, but once on the Wetlet lake; often in company with white-necked storks and sometimes with eastern grey herons. Usually singly, or in small parties, but more than once in flocks of 30 to 40. On 25 February 1932 I watched a bird soaring in circles about 300 ft. up for 5 or 10 minutes, when it went off westwards.

Status.—Seen in every month from October to April, except March, and fairly common. Earliest date 29 October, latest 22 April. The latter observation was of a solitary young bird feeding with a large number of white-necked storks; young birds were seen in October and December also.

Dissoura episcopa. The White-necked Stork.

Local name: *Paung-gya,* according to boatmen on Wetlet lake.

Habits.—From October to April, it was generally seen in parties or flocks, usually of not more than 20, but once of 65. In other months it was solitary or in pairs, except for a party of 3 on 10 June. Sometimes seen in company with black storks or adjutants, usually in wet borrow-pits or fields, or in shallow canal pools, but occasionally in jheels, once on a sandbank in the Mu, and once two birds on the extreme tops of adjacent tall dead trees.

Status.—Common. Observed in every month, but no nesting seen.

Xenorhynchus asiaticus. The Black-necked Stork.

Local name: *Hnget ton-sat* is the only one I have heard.

Habits.—Seen mostly along canals, but sometimes on Wetlet lake and the Mu river, once in the Mahananda tank, and once in wet paddyfields. Only once seen associating with other birds, when two birds were in a large mixed flock of white-necked and black storks. On one occasion at Wetlet, I saw a bird drop from a considerable height to the lake like a stone.

Nesting.—No nests found, but on 26 September one year I saw a bird in flight carrying a stick. A young bird was seen on the river bank with its parents on 18 January, and birds in immature plumage were seen at various dates between then and 9 October.

Status.—Seen in every month except June and August, and quite common.

Leptoptilos dubius. The Adjutant.

Identification.—Of three birds seen on 1 July 1931, one had red on head and neck, in the other two those parts were almost white. The gular pouch of a bird seen on 30 July 1932 was conspicuously red. Another seen on 13 August 1932 had the neck yellow and the gular pouch orange-red.

Voice.—A curious creaking noise heard in flight in August sounded at first as if it came from the throat, but was actually, I decided, made by the wings.

Habits.—Sometimes seen singly, and equally often in pairs or parties of up to 5, but occasionally in larger flocks of up to 15. Seen twice with vultures, twice with white-necked storks, and once with a sarus crane. Most frequently in wet fields or swamps, but sometimes in jheels or canal-beds, and once in the Mu river bed. I only twice saw it perched, both times on the top of a tree, and twice soaring high up.

Status.—Seen in every month from 22 April to 24 November, though never common. Except for a single bird on 28 February, never seen outside that period. In the Mandalay canal area I once saw a flock of 15, on 2 August. It seems as if they breed in Lower Burma, and move to Central Burma and possibly further north for the rest of the year.

Leptoptilos javanicus. The Smaller Adjutant.

Status.—Between 14 June 1932 and the following 3 August, birds were seen several times in the Mahananda tank. At first there were only two, but by 12 July their numbers had increased to five and a pelican had joined them. On 3 August, only one bird was left. No other observations.

Ibis leucocephalus. The Painted Stork.

Local names: *Hnget-sat* and *Hnget-sat-kya* were the only names I heard in Shwebo.

Habits.—Usually in jheels or wet fields, but once in the Mu river bed. Sometimes single, but more often in small parties, or flocks of up to 50. Usually by themselves, but once with scores of grey herons, openbills and geese. One flock I saw was scattered into ones and twos to feed. Two birds which I watched feeding in the Mu were holding the open bill half under water and walking slowly along. A young bird I saw in shallow water in the Mahananda was scratching up the muddy bed with its feet.

Nesting.—Not observed in Shwebo, but on 22 November 1926 I watched a bird nest-building on the top of a tall tree on the bank of the River Myitnge in Mandalay district.

Status.—Seen fairly commonly in every month from 3 July to 9 November, but, except for four birds on the Wetlet lake on 29 January 1934, not seen outside those dates. In the Mandalay canal area, however, I have seen large flocks in March and April.

Anastomus oscitans. The Openbill.

Local Names: *Youk-tha-kwe, Hnget-pya-gya* and *Hkayu-sok* were all heard.

Identification.—Flocks of up to several hundred seen in October and November were all in the non-breeding grey plumage. I saw a party of three birds, all in pure breeding plumage, as early as 17 February, and a flock of 10 to 15 in the same state on 3 April. On the other hand, some of a flock seen on 14 May were still in winter plumage and some were in process of changing, and on 8 June a few of a large flock were still in winter plumage.

Habits.—Occasionally seen singly or in small parties, but as a rule in flocks, sometimes numbering several hundreds. Generally by themselves, but sometimes with white-necked storks, white ibis, egrets and others. Seen mostly on jheels (though not on the Mahananda during the rains) or along canals, but sometimes in the Mu river bed and occasionally in fields. Only once seen perched, when a flock of 30 were in a bare tree.

The flocks occasionally scatter to feed, and in the dry weather they were fond of feeding in the *mayin* paddy growing in the jheels. On 4 September 1933, at sunset, an endless stream of birds flew off from the Wetlet lake towards the Kadu lake, but were back at the former the next evening. By 7 September, however, there were none to be seen there, possibly owing to recent heavy rain having spoilt the feeding. They were still absent on 9 October.

Status.—Common in most months, but never seen between 14 June and 4 September.

Ardea purpurea. The Eastern Purple Heron.

Identification.—I always found the striped neck a most distinctive feature, also the apparent greater length of the neck compared with the grey heron. In a low sun the purplish tinge on the grey wings is distinct.

Voice.—The squawk uttered almost continually as a bird circles overhead reminded me once or twice of a night heron.

Habits.—Except for one bird seen in flight at Kabo, I only saw it at the Mahananda tank and the Wetlet and Kadu lakes. Twice seen perched on tree-tops.

Status.—Observed in January, May, and monthly from September to December. Numerous on the Wetlet lake in October and November. It is doubtless commoner than it seemed to be.

Ardea cinerea. The Eastern Grey Heron.

Habits.—Seen in parties and flocks as often as singly, especially in the cold weather. One January I saw twelve birds fly off together from the Mahananda tank, one November eleven birds were together on a sand-bank in the R. Mu at Kabo, whilst I once saw twenty standing together in Wetlet lake. On another occasion I saw thirteen birds flying high in V-formation. Within a small area in Wetlet lake I have seen many scores of them with painted Storks, openbills, geese and other birds.

A bird was once seen holding out its wings to dry like a cormorant, and another perched on the top of a post like that species. A number of birds were seen one day in November perched on the extreme tops of trees.

Nesting.—None observed, but young bird seen on 1 September.

Status.—Common in every month; rather less so from June to August, and more so from October to February.

Egretta alba. The Eastern Large Egret.

Identification.—With practice I found it often possible to distinguish this bird without doubt from the smaller egret, even out of the breeding season and when by itself, by its larger size. There was, of course, no difficulty when the two were seen together, and, when seen with grey herons, its approximation to the size of that bird was enough to identify it.

A bird seen on 14 August had only the extreme tip of the bill still black, but one seen on 9 September still had the black tip.

Habits.—Seen once in June roosting in tamarinds with smaller and little egrets. The absence of breast plumes in this species and their presence on the smaller egrets was very noticeable. One bird on this occasion was holding its wings out like a cormorant, and some pairs were making love by touching each other's heads. As stated above, I have seen it also in company with grey herons.

Most birds identified were on the Mahananda tank or Wetlet lake, even in July, and October, and either this species or the smaller was numerous at Wetlet in September. In August, however, I only saw this species in paddy fields and canal-beds.

Status.—Not identified in the area between 26 February and 14 June, though either this species or the smaller was seen in April 1932 and April 1933. Observed in every other month, and fairly common.

Egretta intermedia. The Indian Smaller Egret.

Identification.—Out of breeding plumage I was often able to identify it by the fact that it was only slightly larger than little egrets and cattle egrets with which it was seen. Sometimes birds seen by themselves were clearly smaller than the large egret.

I once saw distinct breast plumes as early as the 23 January, and have seen scanty ones present as late as 7 September. Back plumes were never seen before 14 May or after 7 September. A partially black bill (the tip turns black first, but turns yellow last) was seen as early as 5 February and as late as 7 September. On 14 May 1933, one bird was seen in full breeding plumage, another with no sign of it, and others in intermediate stages. More than once I saw birds that had lost the black bill and back plumes, but still retained the breast plumes; but never *vice versa*.

Habits.—Seen throughout the year mostly on jheels, but occasionally in the Mu river-bed and in canal-beds and wet fields. Flocks were seen in all seasons, but in the rains it was more often seen singly.

I once saw it roosting in tamarinds with large and little egrets, and once in a big pipal with little egrets, pond herons and crows.

Status.—Observed in every month, and I would say commoner than the large egret.

Egretta garzetta. The Little Egret.

Identification.—Some birds wear their crest plumes for a great part of the year. I have seen birds with them as early as 6 April, and few were without them by 20 April. I saw them continuously from then to January, and saw several birds with long plumes as late as the 24 of that month. Back plumes were seen as early as 20 April, and breast plumes on 26 April (this bird had no crest or back plumes). A bird seen on 14 May had the full crest plume, and back plumes just appearing, but no sign of breast plumes. Another one seen on 15 August was in exactly the same state, but was presumably shedding, not growing, its plumes.

Habits.—Seen in parties or flocks at all seasons, but seldom singly during the rains. During the dry weather it was usually seen in the canals, but sometimes in the jheels and occasionally in the Mu river-bed. In the rains it was most often seen in the jheels, but occasionally perched in trees. I have two records of it in mixed flocks with cattle egrets.

I have seen them roosting in tamarinds with large and smaller egrets, and in a big pipal with smaller egrets, pond herons and crows.

It is sometimes very bold. On one occasion in July a bird remained standing on a canal bank while I passed within two yards of it on a motor-cycle.

Nesting.—Twice in early June birds were observed on nests in *tanaungbins* in or near bungalow compounds, with pond herons also on nests in the same trees. The little egrets' nests were about the same size as the pond herons' but more compact. On my approach to one such tree, all the little egrets left their nests and perched on the crown of the tree, while the pond herons sat tight.

Status.—Seen in all months. Common, especially in the dry weather.

Bubulcus ibis. The Cattle Egret.

Identification.—Earliest signs of breeding plumage seen on 3 April. On 16 April nearly all of a flock of 20 were in partial breeding plumage, most noticeably on the head and neck. On 2 July 12 birds out of a flock of 16 were pure white, and on 18 August about half of a flock were in that plumage. Possibly these were young birds.

On 13 November 1932 a bird which flew up into a tree had the usual yellow bill and black feet, but a white crest plume just like a little egret's.

Habits.—In the rains seen mostly on Wetlet lake and Mahananda tank. In the dry weather seen all over the area indiscriminately, including Shwebo town.

During the rains I saw solitary birds several times, but never in other seasons. In October I once counted a flock of more than 400 in the bed of the Mahananda tank, and saw a very large flock in early May also.

In December I have seen mixed flocks of this species and little egrets. On 4 January 1931, at Shwebo, numerous flocks were flying northwards in the evening, many of them followed at a short distance by a single bird, as though acting as a rearguard. On one occasion in June a single bird settled for a few moments among a number of large, smaller and little egrets roosting in a tamarind tree. I noticed them on other occasions roosting or nesting in tamarinds, to which they seem to be partial.

Nesting.—The only nests observed were on 30 May 1933, when several dozen birds were seen nesting in a group of tamarinds in the middle of Shwebo town. Many of them were sitting.

Status.—Seen in every month; especially numerous in the latter part of the rains and in the cold weather.

Ardeola grayii. The Indian Pond Heron.

Identification.—Many birds were seen on 3 April 1931 in full breeding plumage except for crest plumes. Some seen on 27 April 1933 had crest plumes as well. One bird seen on 30 July 1933 was in process of changing plumage, and one seen on 16 August 1933 was in non-breeding plumage. Of a number seen on 4 September 1932, some were in breeding plumage, others not.

Habits.—I once saw one perched on top of a stick in water, among many cormorants on similar sticks. A number of other pond herons were present, standing in or at the edge of the water as usual. Possibly a case of mimicry of behaviour.

Nesting.—On 8 June 1932 one of a pair settled on a nest in a tamarind. Another bird was breaking off dead twigs, and several others fluttering about in the tops of the trees, making a great noise with their wings and croaking. On the same date in 1933, I saw a bird sitting on a nest loosely built of sticks in a *tanaungbin* in a bungalow compound, with a little egret on another one within 2 ft. Two days later, in a large *tanaungbin* in another bungalow compound, two birds were on nests near the ends of branches. Little egrets again had nests in the same tree. On my approach the egrets flew off, while the pond herons sat tight.

Status.—Common in every month, especially from November to May.

Butorides striatus. The Little Green Heron.

Status.—Only seen twice for certain in the area. On 6 December 1931 a bird was observed in the Mu river bed at Yeu, flying along the water's edge, and standing on the bank. On 16 March 1933 a bird flew out from the grassy bank of the Mu at Kabo, settled on a sand-bank and erected its crest. On

11 September 1932 a bird, which I think was this species, settled in paddy in the Yeu canal area. Birds seen on 13 December and 27 January, and taken at the time for black bitterns, were, I think, more probably this species.

Nycticorax nycticorax. The Night Heron.

Identification.—In Mandalay, birds with white spots on the wing, presumably young ones of the previous year, were seen on 20 March.

Habits.—Usually heard or seen in flight close to bungalows, including my own in Shwebo town. But I once found a large flock roosting in bushes in the old Mu canal. In the Mandalay district, I once put up a flock of 30 or 40 from trees on the berm of the Fort Dufferin moat.

Status.—Heard or seen in every month from September to February. Except for one rather doubtful occurrence on 7 June, not observed between 14 February and 10 September.

Ixobrychus sinensis. The Yellow Bittern.

Local names: *Gyayn-sa* and *Byaing-sat* both used by boatmen on Wetlet lake.

Status.—On three occasions between 2 July and 9 October I saw two or more birds on the Wetlet lake. They were seen both on the edge of reed-beds and in flight close to them. One bird got up from the edge of a reed-bed in 2½ ft. of water. Not seen elsewhere in the area.

Ixobrychus cinnamomeus. The Chestnut Bittern.

Local name: *Sat-byaing.*

Voice.—In the Mandalay district I once saw a bird uttering a call very much like the clucking of a domestic hen.

Habits.—Usually seen singly, but several times in pairs. Most often in wet fields and swamps, but also in jheels and small tanks. Once in the Mandalay district I saw one settle in a tree, and in the Shwebo area I once watched a female or young bird (probably the latter) perched 6 ft. up in a bush in full view. Otherwise I only saw them in flight or on the ground. One bird I put up in August from a paddy field flew at least half a mile before settling again.

Nesting.—Not observed, but on 30 July 1933 I saw a bird sitting very close inside a ring of mud among clumps of grass in a wet field, preening its breast and freezing at frequent intervals. It allowed me to approach to within 10 yards.

Status.—Fairly common from June to September. Not seen between 10 September and 25 June. Early in November 1933 it appeared to be absent from the Wetlet lake, as none were seen between the 8th and 10th of the month, when most of the lake was explored. Probably a local migrant.

Dupetor flavicollis. The Black Bittern.

Status.—Only seen four times, all between 18 June and 26 July, in jheels, wet fields and swamps. On one occasion two or three birds were together, on the others the birds were solitary. One bird flew up from long grass and settled 10 ft. up in a bush. Another one, in July, was standing in the open at mid-day in a few inches of water.

Sarkidiornis melanotus. The Comb Duck or Nukhta.

Identification.—The development of the male's comb seems to vary considerably. I saw one bird on 7 June 1932 with a very large comb, but others on 5 July 1932 and 5 July 1933 with quite small ones. Three birds in adult male plumage on 14 May 1933 had no sign of a comb. Not one of a flock of 7 seen on 10 October 1933 had any comb, but it is possible that they were all females.

Habits.—Seen occasionally in the rains in paddy fields and water channels, but mostly on the Mahananda tank and Wetlet lake, both in the rains and the dry weather. In the rains usually seen singly, but in the dry weather always in pairs or flocks. The biggest flock I saw, however, was one of 13 on 7 September 1933. This flock was flying in V-formation, with two leaders. On 3 September 1932 I saw a solitary male with a flock of 15 Burmese grey duck, and on 26 April 1933 two birds with a flock of small whistlers.

Status.—On 23 January 1933 there was a flock on the Wetlet lake; otherwise I never saw a bird in the area between 10 October and 26 April. They appeared to be absent from the Wetlet lake on 8, 9 and 10 November 1933, 16 December 1933, and 29 January 1934. On 16 December 1933 my boatman said that they would probably arrive in ten days' time, but I do not know if they did so. I saw them fairly commonly in all other months of the year. Possibly a local migrant.

Nettapus coromandelianus. The Cotton Teal.

Habits.—Apart from a single bird seen on the R. Mu on 5 May 1933, I only saw it on the Wetlet lake and Mahananda tank. It was occasionally solitary, but usually in pairs, small parties or flocks of up to 40 or more, irrespective of the time of year. I once saw several birds in company with a number of little grebes, otherwise it was always apart from other species.

Status.—Seldom seen from June to September, or from November to January. Fairly common in other months.

Anser anser. The Grey Lag Goose.

Voice.—I found them very noisy on the Wetlet lake in December.

Status.—On 9 November 1933 and 11 December 1932 there were hundreds of birds on the Wetlet lake; On 22 January 1933 there were only a few, and on 23 January 1934 there were none, the local people saying that they had departed for the season. On the 4th of that month I had seen a flock of about 100, and on the 6th one of 20 birds, flying north over Shwebo in the early morning. The first flock arrived in V-formation about 200 ft. up, but broke up considerably over the town.

? **Anser albifrons.** The White-fronted Goose.

Status.—On 23 January 1934 I saw two birds on the Wetlet Lake, which I took at first for grey lag, but my boatman was very definite that they were not, and called them *Gya-ma.* I have heard that name applied to the Burmese grey duck, but they were clearly not that species. The fore-neck and breast were light grey, the rest of the plumage mostly grey, with a little white on the head, and white on the rump or upper tail-coverts. Possibly they were young birds of this species.

Dendrocygna javanica. The Lesser Whistling Teal.

Status.—On 22 January 1933 I saw a small flock on the Wetlet lake and on 21 August 1933 two birds in flight at Kabo. Otherwise I only saw them on the Mahananda tank and only during the dry weather of 1932-33. On 18 December 1932 and again on 8 January 1933 there was a flock of about 25 there. By 27 March there were hundreds of birds, and there were still hundreds of them on 30 April. On 14 May the numbers were reduced to about 12, which were last seen on 21 May. Possibly a local migrant.

Dendrocygna fulva. The Large Whistling Teal.

Habits.—Except for one bird put up from the foot of a canal bank, I only saw it on the Mahananda tank and Wetlet lake. I twice saw single birds; otherwise they were seen either in pairs or in flocks. Flocks were usually about 12 strong, but I once saw a large one on the Wetlet lake. Usually apart from other species, but once seen feeding among egrets. In August and September I found them very tame, allowing a close approach.

Status.—Never seen between 23 January and 8 May. Fairly common during the rest of the year.

Tadorna tadorna. The Shelduck.

Status.—In the cold weather of 1933-34, I twice saw this bird on the Wetlet lake. On 16 December 1933 there were two adults and a young bird swimming, feeding and walking about in the mud—a magnificent sight. On 29 January 1934 I saw a party of 4 birds, standing in shallow water and flying about.

Casarca ferruginea. The Brahminy Duck.

Voice.—The call reminded me once or twice of that of the grey lag goose.

Habits.—Seen in the Mu river bed, and also at the edge of the Wetlet lake, even on 22 January. In that case there was a flock of 8 to 10 birds; on the other hand a pair was seen in the Mu river bed as late as the 16 March. On the same day three birds were seen with a flock of Burmese grey duck—the only time that I saw them with other species.

Status.—Only seen 5 times in the area. Earliest date 9 November, latest 16 March.

Anas platyrhyncha. The Mallard.

Status.—Two drakes and two ducks were seen feeding on the Mahananda tank on 30 January 1933. No other observations.

Anas poecilorhyncha. The Grey Duck.

Local name: *Gya-ma* (Wetlet lake).

Identification.—A bird seen on 5 July 1933 had both blue and green in the speculum, which was conspicuous.

Habits.—Mostly seen on the Mahananda tank and Wetlet lake, at all times of year, but several times in paddy and other wet fields, and occasionally in canal-beds and the Mu river bed. Occasionally seen singly, but mostly either in pairs, small parties or flocks, irrespective of the season. An unusually large flock of about 40 was seen on the Mu river at Kabo on the morning of 16 March 1933, they flew right off to the north. On the evening of the same day, however, two small flocks of 6 to 8 birds arrived from the north and settled on the water. Once in August I saw two birds settle in a tree about 40 ft. up—the only time I saw one perched. Four other birds seen in the same month were unusually tame; they were feeding only about 100 yards from a village, and let me approach in full view to within about 75 yards.

Status.—On 7 May 1931 I saw a pair with blue speculums on the Mahananda tank, which were presumably the eastern race. As far as I know, all other birds seen were the Burmese race. I recorded the bird in every month except April, and it was fairly common, though for some reason it appeared to be absent from the Wetlet lake in November and December 1933.

Anas crecca. The Common Teal.

Local names: *Be-gya, Be-daung-gya.*

Habits.—Only seen on the Mahananda tank and Wetlet lake. A solitary male, much tamer than usual, was seen in the Mahananda on 14 February 1934. In December I have seen literally thousands of birds on the Wetlet lake. I have seen them in company with Garganey teal and with cotton teal.

Status.—Earliest date 9 October, latest 14 February.

Anas acuta. The Pintail.

Local name: On the Wetlet lake it was always called simply *Yit.*

Identification.—One of a flock of 12 seen on 10 October 1933 was a drake already in full plumage. On 10 November 1933, several drakes in full plumage were seen by themselves, and on 23 January 1934 they formed a large proportion of a flock many hundreds strong. It seems, therefore, that old drakes of this species migrate further south than those of most ducks. Their tails usually appeared less elongated than in the breeding season in Europe.

Habits.—On 18 January 1934 a single drake settled on the Mu river at Kabo. Otherwise I only saw them on the Wetlet lake, in flocks of from 12 birds up to many hundreds. Most of the latter flock were standing asleep on the *kazins* which were protruding above the very shallow water. As they all stood facing the sun, the white breasts of the drakes were very conspicuous, and the whole effect was magnificent.

Status.—Earliest date 10 October, latest 23 January.

Anas querquedula. The Garganey or Blue-winged Teal.

Local name: *Be-bya-galay* (Wetlet lake).

Habits.—Only seen on the Mahananda tank and Wetlet lake. In April in three successive years I saw solitary drakes on the Mahananda, and once

saw a pair there; otherwise they were always seen in flocks, numbering from 8 birds up to many hundreds, sometimes in company with common teal. On several occasions I saw them feeding by day.

Status.—Common in the cold weather, earliest date 2 October, latest 7 May. Also seen on 26 April.

Spatula clypeata. The Shoveller.

Local name: *Ama* (?)

Habits.—Seen several times on the Wetlet lake, singly and in small flocks, once with common teal.

Status.—Uncommon. Earliest date 8 November.

Aythya rufa. The White-eyed Pochard.

Status.—Only seen once in the area, on 18 February 1933, when a flock of 6 birds was swimming and diving in the Mahananda tank. White under the tail distinguished them from tufted duck.

Aythya fuiigula. The Tufted Duck.

Local names: *Myo-ma, Nyoo-hmat.*

Habits.—Seen only on the Mahananda tank and Wetlet lake, usually in flocks of anything from 5 or 6 birds upwards. Seen once with a flock of coots.

Status.—Not very common. On 2 July 1933 I saw two birds on the Wetlet lake. I was able to take detailed note of their plumage and have no doubt of their identity. Apart from that observation, the earliest one was 11 November, and the latest 12 February.

Podiceps cristatus. The Great Crested Grebe.

Status.—Only seen once, on 29 November 1933, when a single bird was swimming and diving in the Mahananda tank.

Podiceps ruficollis. The Indian Little Grebe.

Local names: *Ongalauk* is the only name I have recorded from this area.

Identification.—I have seen birds with the chestnut head of breeding plumage as early as 26 April, and others with the sides of the head still chestnut as late as 31 January.

Habits.—Seen only on the Mahananda tank and Wetlet lake; commoner on the former than on the latter. Between 24 July and 2 October, I only saw it singly or in pairs, and from then up to the end of November never in parties of more than a few birds. From December to July, however, it was always to be seen in large numbers on the Mahananda tank. I have a note of hundreds there on 26 April. I noted a preference for water with green scum on it.

Nesting.—None observed, but I have seen young birds being taught to dive on 10 October.

Status.—Seen in every month, but scarce from the end of July to early October.

THE STUDY OF INDIAN MOLLUSCS

BY

JAMES HORNELL, F.L.S., F.R.A.I. (Deceased)

PART III

(*With 19 text figures*)

(*Continued from p. 569 of this volume*)

ORDER II.—EULAMELLIBRANCHIA

In this order the gill filaments are united at regular intervals by cross branches. Except in the oysters and a few others, two adductor muscles are present. Many have the edges of the mantle lobes united at three places posteriorly and the margins are often prolonged into tubular siphons, sometimes quite short, sometimes extremely elongate.

Edible Oysters

The true Edible Oysters (*Ostreidae*) are among the least typical of the order and have much in common with some of the preceding order, particularly with the Scallops and Spondyles. They all live a fully sedentary life after the early free-swimming stage is past; the description of the larval life of the Pearl Oyster is identical with that of our Indian Edible Oysters. Once they settle to the bottom they turn over upon the convex or deep valve and cement this to whatever hard object is handy, preferably a stone or another oyster, for they are gregarious and form regular beds. Sometimes they may even attach to the aerial roots of mangroves in backwaters. Their value to mankind as food is greater than that of any other mollusc; they are susceptible to great improvement under cultivation.

The Common Backwater Oyster of India (*Ostrea virginiana*) is the only species deserving to be called the Indian Edible Oyster as it is the one that lends itself most readily to cultivation. It is extremely variable in form and passes under many names, scientific as well as local. Among the more recent of the scientific names under which it has been described are *O. gryphoides*, var. *cuttackensis* in the *Records of the Indian Geological Survey*, and *O. madrasensis* by Preston[1]. It has, however, no outstanding differences from the common American species (*O. virginiana*) and I agree with Vredenburg in believing it to be in no wise separable from this widely distributed form. It is very hardy and can sustain considerable fluctuations of salinity. Hence it thrives in nearly every estuary and backwater. On the Malabar coast and in Cochin these oysters have considerable value to the poorer populations living in the vicinity; the Madras Fisheries Department has a model oyster park in Pulicat lake whence large quantities of cultivated oysters are

[1] Preston, H. B. 'Report on a Collection of Mollusca from the Cochin and Ennur Backwaters'. *Records of the Ind. Mus.* vol. xii, pt. 1.

supplied during the season, certified to be hygienically safe to eat. The Indus creeks are another famous source of oyster supply, consignments being sent from Karachi to all important centres in north-western India.

The season when oysters are in marketable condition depends upon the time of spawning, and this, in turn, is controlled by rainfall and sunshine. Heavy rains causing flood water to enter backwaters in such amount as to lower greatly the salinity of the water over the beds invariably entails wide-spread emission of the reproductive products when the gonads are ripe. Hence as the rainy season differs on the west and the east coast of India, there is corresponding divergence in the spawning maxima and the marketable season in these two localities. The dry season on each coast is, therefore, roughly synchronous with the season when oysters are in prime condition in each respective locality.

Rock Oysters

Rock Oysters (*O. crenulifera*) are readily distinguished by the deep ridge foldings of the convex left valve and by its deeply crenulated or lobed edge which tightly interlocks with the margin of the upper or right valve, which is flattened and opercular in form. The adductor muscle scar of both is usually dark purplish-black in tint, rarely white. Very characteristic is a row of closely set elongated denticulations seen a short distance inwards from the margin on the inner surface of the upper valve; these fit into a corresponding series of furrows in the lower valve. Externally the shell is tinted an opaque pinkish purple. Internally it is white, margined with purple or black. The size is generally smaller than that of the backwater or mud oyster and seldom exceeds three inches in length, except when living isolated, when it may grow considerably larger.

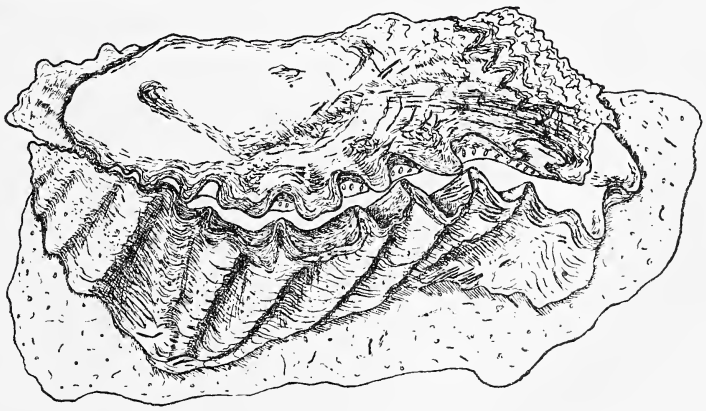

Fig. 52.—The Rock Oyster (*Ostrea crenulifera* Sowerby).

The habitat of Rock Oysters is within a narrow belt between tide-marks; during spring tides they are entirely uncovered at low-tide. They are purely a marine species, never forming beds in backwaters or estuaries. Under favourable conditions they form densely

crowded colonies upon rocks between tide-marks. They are particularly common on rocky shores from Sind to Malabar; much less abundant on the east coast. They are of excellent flavour but on account of their small size, both natural and usually further reduced by overcrowding, as well as by the difficulty experienced in opening them by reason of their interlocking edges, they are of insignificant economic importance.

Cockscomb Oysters

The third species of Indian Oyster is the Cockscomb Oyster (*O. crista-galli*), a massive form occurring on stones and shells, chiefly on the east coast. The edge of the valves are deeply pleated and these pleats are continued on the surface of the valves as angular ridges and furrows extending radially from the hinge. In the Rock Oyster similar pleats occur but they are more numerous and much shallower than in the coarsely pleated Cockscomb species.

Pinna

Several species of Pinna (*Pinnidae*) occur in Indian waters. The most common one is *Pinna bicolor,* a big wedge-shaped shell often a full foot in length that occurs commonly on sandy bottom on the east coast. It lives in depths from just below low-tide to about six fathoms. The umbones are at the apex of the wedge, the hinge-line along the length of one of the two long sides. It lies buried to more than half its length in sand, point downwards, the edges of the upturned wedge-base gaping. It is very common in the beds of sea-grass along the south end of Palk Bay, the knife-

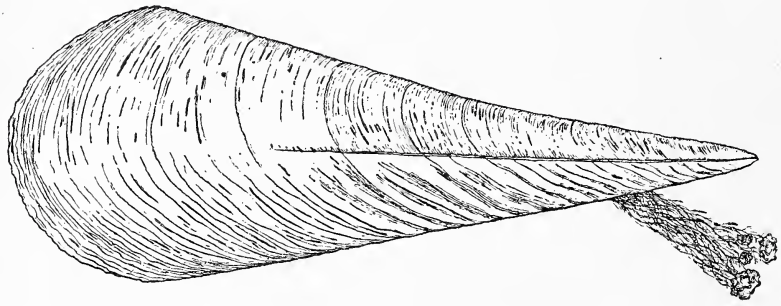

Fig. 53.—*Pinna atropurpurea* Sowerby, showing the tangle of fine byssal threads attached to two pieces of gravel.

like edges of the posterior margin protruding a couple of inches or more above the sand. Pearl Oysters sometimes settle in numbers on these projecting edges. In the 1905 Ceylon Pearl-fishery when some millions were fished from such foothold, the divers complained bitterly of the injuries that their hands received when pulling the Pinnas out of the sand; as many as a dozen Pearl Oysters sometimes clung to one Pinna—the reason being that the area fished was almost all sand where the projecting shell margins of the Pinnas were the only stable objects to which the Pearl Oysters could cling.

Pinna has a long tongue-shaped foot and spins a strong byssus of very fine silky fibres, wholly unlike the coarse strands of the byssus of the Pearl Oyster. Occasionally thread has been spun from these fibres and silky gloves and stockings woven therefrom but these are mere curiosities and have no commercial importance.

A second species, shorter and stouter, the *Smoky Pinna* (*Pinna fumata*) is common in five fathoms in Palk Bay. From the Laccadive Islands a third, *P. zebuensis*, is reported.

The False Cockles

The False Cockles (*Carditidae*) are often uncommonly like the English cockle, thick and heart-shaped and deeply ribbed with radiating ridges. Typical of this form is *Cardita bicolor,* a coarsely ribbed species unevenly spotted with dark red on a ground rendered yellowish by thick periostracum. It is common everywhere on coarse sandy or even gravelly bottom. Like the cockle the foot is sickle-shaped and highly muscular; by its aid these molluscs are able to hop along the ground. *C. rufescens* is found in the Laccadives.

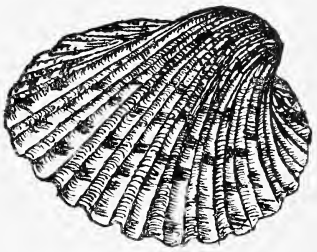

Fig. 54.—*Cardita bicolor* Lam.

A circular outline and a pure white shell are features very general among the *Lucinidae*. The form of the anterior adductor muscle scar is still more characteristic; it is of unusual length and for the most part lies separate a little distance within the pallial line. *Lucina cumingi* is typical, with a long vermiform foot longer than the length of the body, specially useful for burrowing in loose sand; it occurs on both the east and west coasts. *L. bella* and *L. punctata* are other Indian species.

The Bladder-Shells

More conspicuous than the ordinary Lucinas is the fine Bladder-Shell (*Cryptodon vesicula*), a thin fragile white shell almost globular in form. Unlike Lucina, which has a toothed hinge, in the Bladder-shell it is weak and toothless. The foot is short. The hemispherical valves, papery and delicate, occasionally nearly two inches in diameter, are sometimes very abundant, thrown ashore by the waves.

Galeommids

The *Galemmatidae* are all tiny creatures, remarkable for the way the mantle folds are reflected over the edges of the valves, nearly concealing them. The foot is long and flattened on the underside after the gastropod fashion and for the same purpose—crawling. To this family is referable the beautiful little creature which I once found at Pamban, *Scintilla hanleyi* by name. As is shown in fig. 55, drawn from life, the inner edge of the mantle is furnished with six long cylindrical tentacles, tapered toward the free ends. These are coloured brown madder, shading from the tip to the base where they grade into the pale buff of the mantle. The

edge of the mantle is in turn bordered by a line of madder running along it while the general surface is covered with many madder

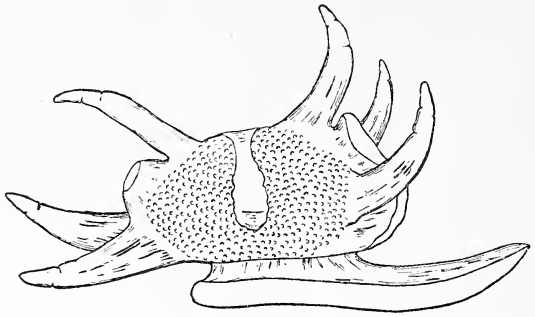

Fig. 55.—A Galeommatid (*Scintilla hanleyi* DESHAYES), showing the flattened crawling foot and the mantle reflected almost entirely over the valves; also two sets of tactile, digitate outgrowths from the mantle. ×3.

brown tubercles. The upper surface of the fore part of the foot is also madder tinted, the base being white.

The **Black Clam,** *Villorita cochinensis*, is our most conspicuous member of the family *Cyrenidae*. It is a small, thick-shelled clam found in west coast estuarine backwaters, where it is associated with the Common Clam (*Meretrix ovum*). Its shell is ribbed concentrically and covered by a coarse, thick, blackish-olive periostracum, frequently worn away by corrosion at the umbo, revealing the whitish shell beneath. The interior is characteristically pale pink in tint. This clam can survive the prevalence of fresh-water conditions longer than the Common Clam; it was originally, as most other Cyrenids still are, a purely fresh-water species, and its presence in quantity in estuarine backwaters, subject during a considerable portion of the year to brackish water conditions, indicates a marked change in its habits and a re-acquired tolerance for saline conditions. It is used by the same people who eat the Common Clam and its valves are also burned for lime in Malabar. It is not nearly so abundant as *Meretrix ovum;* its habitat also is usually farther distant from the sea. The shell seldom exceeds 30 mm. in length.

The Fresh-water Mussel

Commonest species in India, the Fresh-water Mussel (*Lamellidens marginalis*), has similar anatomy to the text-book types so well known to biological students under the names of *Anodonta* and *Unio*. It is very widely distributed and is occasionally eaten by the lower castes, especially in Ganjam. There and in Vizagapatam the valves are used as mango peelers. To prepare one, a hole is made in the convex umbonal region by rubbing this part, usually of a right valve, upon a stone till a hole of the right size is formed; to use this peeler it is grasped in the hand with the hollow side against the palm and then the sharp edge of the hole is used to peel off strips of skin. The advantage claimed for this implement over a knife is that the mango does not become stained and its flavour impaired by contact with steel.

This species, although its shell is normally too thin to be of use in pearl-button manufacture, sometimes produces pearls in considerable quantity and of fair quality. Occasionally they are offered

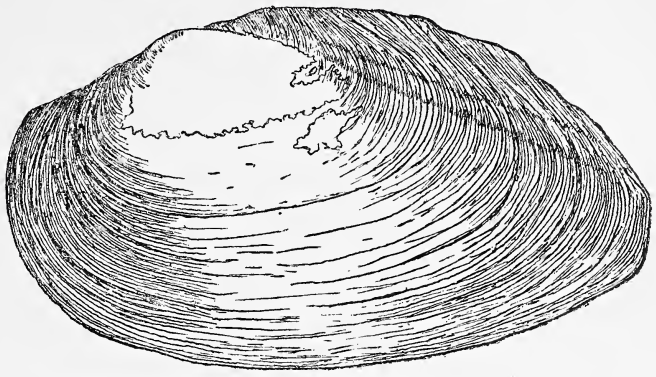

Fig. 56.—The Fresh-water Mussel (*Lamellidens marginalis* Lam.).

in the Surada bazaar (Ganjam); these are obtained from mussels found in a great irrigation reservoir in the neighbourhood. The pearls have a reddish tint and less lustre than those from the marine Pearl Oyster.

This species is notable in that I was successful in inducing the formation of free pearls in numerous individuals; the *modus operandi* was simple. Having gagged the valves open, I pushed large grains of sand into the substance of the posterior adductor muscle with the help of a pair of fine pointed forceps; the mussels were then returned to the water and left for the pearl sac to form and lay down onion-like concentric layers of nacre. Unfortunately the tank threatened to run dry at the end of three months and I had to remove the mussels and dissect them to ascertain the results. These agreed with those I had obtained in 1908 from experiments made on Pearl Oysters in Ceylon.[1] The sand grains had become coated with nacre and while those induced in the Pearl Oysters were perfectly spherical as they were formed within the mantle where they were not subject to pressure, those produced by Lamellidens were misshapen and wrinkled owing to the pressure of the fibres of the adductor muscle; still, they were true pearls and had been induced by artificial means. It was as the result of this success and of the Pearl Oyster experiments above recorded that Lord Pentland, then Governor of Madras, sanctioned the purchase of Krusadai Island, near Pamban, with a view to establish there a pearl-oyster farm for the production of culture pearls after the method which I had planned to carry out. Unfortunately the 1914-1918 war broke out and although the island was purchased and buildings put up, financial stringency caused the abandonment of the scheme.

A larger species common in Bengal is extensively utilized for button manufacture. An allied genus, *Parreysia*, has coarser hinge-teeth and generally a stouter shell.

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[1] See *Proc. Linn. Soc.* for 1940-41, pp. 144-149.

The Tellinas

The species of Tellina (*Tellinidae*) most common on all our sandy shores is small and pink-shelled, about $\frac{3}{4}$ inch long, compressed from side to side. The anterior end of each valve is rounded, the posterior shorter and slightly angular; the ligament is external, showing as a prominent black hinge behind the beak or umbo. The marking on the inside of the valves is distinctive; the pallial sinus which marks the position of the siphons when withdrawn into the shell, is extremely long, extending from the hinder margin nearly to the anterior adductor. Without seeing the living animal a zoologist can tell from this that it must have long siphons. In Tellina the siphons exceed twice the length of the shell; they are formed by the tubular outgrowth of the mantle edge at the posterior end of the body; the evolution of these siphonal tubes in bivalves is particularly interesting, for among our common shells we find a full gradation of transitional stages, beginning with instances where the siphonal openings, one incurrent (to the gills) and one excurrent or anal, are formed by the temporary coming together of the mantle edges of opposite sides at several definite points, thus forming temporary openings. The next stage is for these temporary junctions to become permanent and then for the edges of the openings to lengthen gradually into tubes of varying length. The Tellinas and their near relatives *Donax, Atactodea* and *Gari* are noteworthy for the extreme length attained by their siphons. The shells are usually small and as their habitat is in shallow water on sandy coasts, seafowl and other birds search the sands for them at low water, to say nothing of predaceous fish that take up the hunt whenever the depth of water permits. Hunted continually, these molluscs lie in deep burrows with just the tips of their siphons level with the surface—as inconspicuous as may be. If discovered they withdraw the siphons into the shells lying below at a depth of maybe a couple of inches and begin with lightning speed to burrow still deeper by the help of their wedge-shaped muscular foot. The longer the siphons the greater the protection; it is significant that the four genera named as having peculiarly long siphons are the commonest bivalves along our sandy shores—infinitely more numerous than those with short siphons. *Tellina virgata* and *T. scobinata* are two abundant species.

The Wedge-Shells

Of the Wedge-Shells (*Donacidae*) two common species are the small *Donax cuneatus* and the much larger *D. scortum*. In outline the former is a small, much compressed bivalve roughly wedge-shaped; the posterior end is obliquely truncate. It abounds between tide-marks and for some short distance below low-tide level. It never enters backwaters and is essentially a marine form. Adult size about 40 mm. in length. On the east coast it is plentiful on surf-beaten sand-flats; along the west coast it is less abundant and is usually smaller. In Tamil districts it is valued by the fisher-folk as an emergency food supply when rough weather cuts off their usual resources. It lies buried an inch or two below the surface layer of sand; the boys who collect it turn over the wet

sand with their feet as each roller spends its force and slips back into the sea.

The larger and more handsome *Donax scortum* is much less common but its strong, boldly sculptured purple-tinted valves are often to be picked up on sandy beaches. The sculpturing takes the form of coarse concentric ridges upon valves roughly triangular in shape. The beak is angular and prominent, the fore end and ventral margin rounded, with the hinder end folded and produced sharply to a bold point. They run to $2\frac{1}{4}$ in. in length and are among the most easily identifiable of our local bivalves.

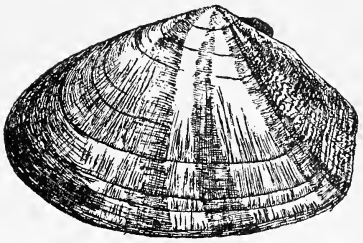

Fig. 57.—A Wedge-Shell (*Donax scortum*, L.). ×1.

Mesodesmatids

The *Mesodesmatidae* are represented by *Atactodea glabrata*, common at times in the sand of our beaches.

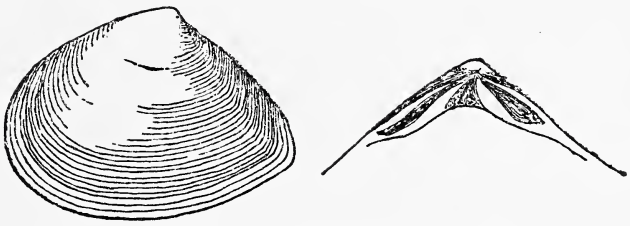

Fig. 58.—A valve of *Atactodea glabrata*, Gmelin., with an enlarged view of the hinge plate. ×1.

It grows to a length of $1\frac{1}{4}$ inch. The shell, strong and massive, is sculptured with bold concentric ridges; the colour is white, but this is obscured by a skin of dirty yellow except near the umbo, where this covering is usually worn away. The ligament is internal as in *Mactra*.

The Mactras

The Mactras (*Mactridae*) are widely distributed on sandy shores and become plentiful when conditions are favourable. They are generally thin shelled and smooth surfaced, more or less triangular in outline, with deep roomy valves, whence the name *Mactra* (Latin—a kneading trough). The ligament, in the form of a triangular pad, is lodged in a deep hollow or pit within the hinge and immediately under the umbo. Several typically thin-shelled species are common on both the east and west coasts. Some attain quite a considerable size and may exceed two inches in length (*M. tumida*), but the best known species is the little *M. corbiculoides*, common in the Adam's Bridge region. Its shell is distinctly trigonal in shape, usually about 30 mm. in length, and with deeply concave valves which are thus able to give accommoda-

tion to a body relatively much larger than can be contained in the shallower valves of the Mesodesmatids. Its colour is most distinctive, externally bluish grey with pink or purplish blue colouring show-

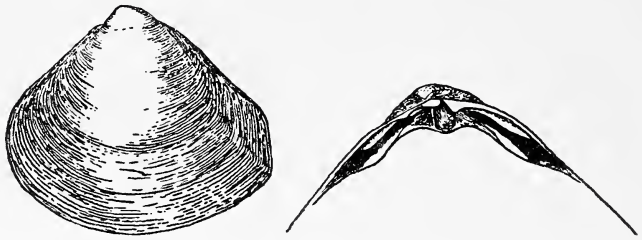

Fig. 59.—A valve and hinge plate of *Mactra corbiculoides* Deshayes.

ing through at the umbo and another similar colour band along the margin; internally the whole surface is tinted a deep violet. When partially bleached the colour fades to a warm pink.

Many of our most familiar and beautiful bivalves belong to the *Veneridae*, small clams characterized by the handsome colouring and great strength of the valves. They vary greatly in shape, from greatly flattened discoidal forms (*Circe scripta*) to swollen ones like *Circe gibba* and oblong ones like *Paphia* and *Sunetta*. The beaks are usually prominent and situated above the mid-length of a strong hinge-plate bearing (usually) three prominent strong cardinal teeth, flanked by long laterals.

The genus *Venus* is purely marine; its shells are ovate with deep crescent-shaped ventral margin and a strongly beaked umbo. Widely distributed on both our coasts, it never forms beds. *Venus reticulata* and *V. plicata* are two common species. The sea-worn fragments of *Venus mercenaria*, strung on leather thongs, were the *wampum* of North American Indians—a rude form of currency.

A wonderfully lovely Cytherea (*Crista erycina*) is found in the channels through Adam's Bridge. It is a thick ovate shell nearly three inches long, boldly ribbed concentrically, splashed and marbled with rich red brown. So handsome is it that the shell dealers in Rameswaram Temple offer good prices for it; they know that its rich colouring will tempt the pilgrims who come here from the most distant parts of India; to them everything from the sea in this holy place is invested with virtue and interest.

Backwater Clams

Much more abundant are the Backwater Clams belonging to the genus *Meretrix*, distinguished by the fine striation of the elongated posterior lateral tooth in each valve. At least three species are of value as food in Southern India—*Meretrix meretrix*, *M. casta*, and *M. ovum*. The first is comparatively scarce but is found scattered along both our coasts, the second is local to the east coast, while the third, *M. ovum*, which may be a sub-species of the second or *vice versa*, is found only on the west coast.[1]

[1] Hornell, J., 'A Revision of the Indian Species of Meretrix': *Records of the Indian Museum*, vol. xiii, pp. 153-173, 4 plates 1917.

Everywhere on both coasts either the second or the third of these bivalves is found abundantly in muddy sand in estuaries and

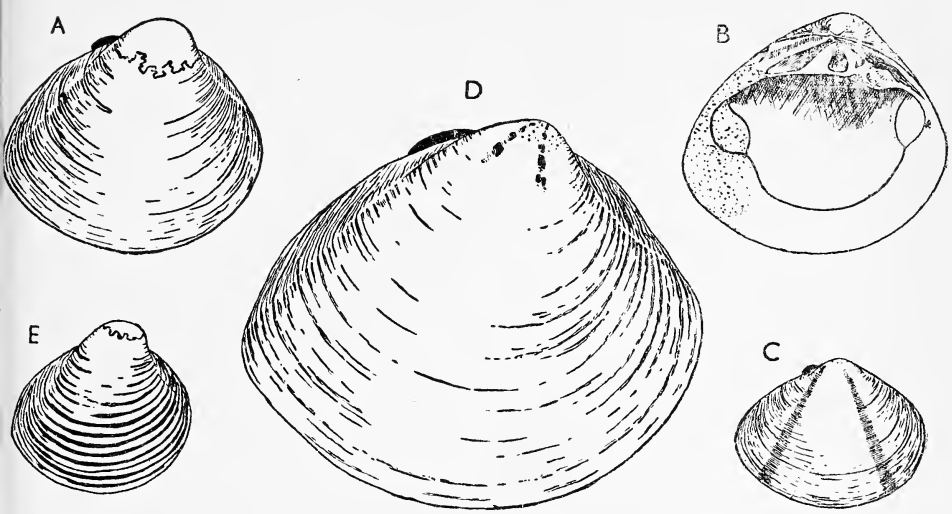

Fig. 60.—Backwater Clams. A and B, *Meretrix casta* Gmelin, outer and inner side of a valve; C, *Meretrix ovum* Hanley; D, *Meretrix meretrix* L.; E, *Villorita cochinensis* Hanley. All are about adult size except E, which is $\times\frac{2}{3}$.

connected backwaters wherever the water remains saline throughout the greater part of the year. Suitable conditions prevail more extensively on the west coast and it is there that these small clams attain greatest economic importance.

Meretrix ovum.—The valves are smooth, grey in general tint and in many, two imperfect brown rays diverge from beak to margin. In shape the shell varies from a swollen cordate form to one compressed and almost almond-shaped. It lives in great abundance in west coast backwaters, with a size-average of from 35 to 40 mm. in length by 25 to 28 mm. in depth; when overfished the average size becomes reduced as few individuals have an opportunity to reach maturity apart from the adverse influences flowing from overcrowding. Two dark rays, often faint and easily overlooked, are characteristic of this species; only occasionally can they be traced back to the umbo; usually they are best marked towards the ventral margin where they often terminate in two small reddish brown patches on the extreme edge. The periostracum is well developed and persistent; it varies from a pale cream to a rufous yellow or even brown, the darker tints being mainly of stain origin.

In India this clam is nearly as important a food mollusc as the Oyster. Its flesh is of good flavour, tender and nutritious. To the poorer classes of shore dwellers, wherever it is obtainable in quantity, it often takes the place of fish in their dietary when this is dear or scarce. The Malabar clam fishers usually use very small dugout

canoes which are anchored when the fishing ground is reached. Men, women and lads all engage in the fishing; the feet are used to locate and dislodge the clams when these occur in shallow water. In deep channels diving has to be resorted to. The usual price is from one to two pies per seer.

On the east coast the place of *M. ovum* is taken by *M. casta*, a rather larger and stouter species of the same habits. Its valves are thick and massive, the exterior covered with a strongly adherent dull brownish periostracum, that varies much in tint even in the same locality. A purplish-black band about a quarter of an inch wide, extends from the hinge to the posterior angle of the shell: unlike the yellow colouring of the rest of the surface, this dark pigment permeates the substance of the valves and shows equally on both the outer and the inner surface. None of the radial banding of *M. ovum* is seen, nor any of the diverse colour schemes of spots and chevrons so often found on the umbos of *M. meretrix*.

Although often very abundant it is generally less common than the corresponding species on the west coast and is held in less esteem by the people. It is, however, eagerly collected wherever it abounds. At Pulicat, for instance, as many as 30 women may often be seen collecting this shellfish in the shallows.

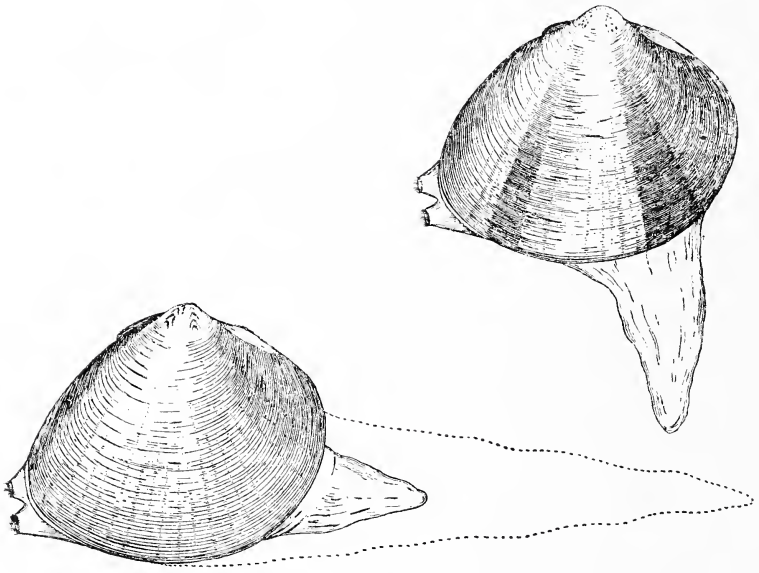

Fig. 61.—Two colour varieties of *Meretrix meretrix* L.; note the two short siphons and the great extensibility of the foot as indicated by the dotted outline. $\times \frac{2}{3}$.

The Great Clam

The Great Clam (*Meretrix meretrix*) is a nearly related species. It is distinguished by its greater size and by the smoothness and delicacy of its periostracum. Its average dimensions when adult

range between 74 × 60 mm. and 75 × 62.5 mm. It is a very beautiful shell and it is a pity it is not more abundant. It lives in sands at the mouths of most of the estuaries and backwaters of India; it seems less hardy than the smaller species and as a consequence its distribution is more local and restricted. It requires a cleaner habitat than *M. casta* and a strong tidal current over the sandbank in which it burrows.

The shell exhibits considerable variation in colouring and at least five well-defined colour varieties are known. Apart from the umbonal region which is frequently rayed, the valves usually exhibit no banding, but in two varieties there are very broad ill-defined radiating bands of a somewhat livid or purplish colour extending from the ventral region half-way to the umbo. Considerable colour is nearly always seen on the umbo itself but this is extremely variable and no two shells are exactly alike. Most frequently a minute brownish speckling can be made out; in others this speckling resolves itself into a pattern of chevron-shaped chestnut markings which may coalesce either into short rays or into concentric zones, never spreading far beyond the umbo. In one variety the colouring is a uniform chestnut.

Circe is another genus of the Veneridae of some economic importance for the little Cockle-Clam (*Circe gibba*) is so plentiful in Palk Bay and the Gulf of Mannar as to form a valued item in the food resources of the poorer classes of shore dwellers. It is a strongly ribbed white shell with a superficial resemblance to the European Cockle (*Cardium edule*), having rugose ridges running radially from the umbo to the margin and being about the same average size. It frequents muddy sands near low-tide level along the open coast. On the Coromandel sands north of Palk Strait it becomes scarce and on the west coast it is either absent or extremely rare. Around Bombay its place is taken by *C. divaricata*, a species consumed in great quantities by the shore people. More characteristic of the true Circes are *C. scripta* and *C. personata*. These have shells greatly compressed laterally and nearly circular in plan, found sparingly in the same localities as the Cockle-clam. The colouring of *C. scripta*, which is the more common of the two, is yellowish, with a broken chevron pattern on the outer half of the valves, suggestive of angular lettering. Closely set concentric ribbing covers the whole surface.

The Tapestry Shells

The Tapestry Shells (*Paphia* spp.), so called from the close ribbing and handsome markings that recall the texture and the patterns of tapestry, are generally oblong in shape with perfectly smooth ventral margins. A superb species is *Paphia adspersa*; it grows to a length of three inches and the fine colouring and bold concentric ribbing of its valves make it one of the most striking of our commoner bivalves. *P. textile* is another typical form, in this case with smooth valves marked with closely-set dark chevrons on a yellow ground. Other smaller species are fairly common on both our coasts; of these, *P. pinguis* is especially abundant in the Bombay area where large quantities are taken at low water by

women grubbing for them in soft dark mud. *P. textile* is another species sometimes offered for sale.

Hemitapes ceylonensis is a handsome inflated species with a superficial resemblance to the Backwater Clam (*Meretrix casta*), being about the same size, shape and colour; it differs, however, in having radiating bands of a reddish brown tint running from the umbo to the margin (Fig. 62). The pallial sinus is much better marked and is deep and angular. Average length, $1\frac{3}{4}$ inch. Flatter and more typical is *Paphia gallus*, strongly ribbed but in its colour closely related to *Hemitapes ceylonensis*; a denizen of the west coast sands.

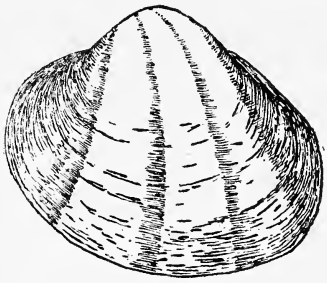

Fig. 62.—*Hemitapes ceylonensis* Sowerby, an inflated form. ×1.

Near relatives of the Tapestry shells are the pretty species of the genus *Sunetta*. Detached valves are common on our sandy beaches, recognizable by their coarse concentric ribbing and attractive colour design usually some arrangement of bold reddish brown chevrons; a fine milling occurs just inside the ventral edges of the valves. They are small shells seldom exceeding $1\frac{3}{4}$ inch in length. *Sunetta meroe* and *S. effossa* are two common species.

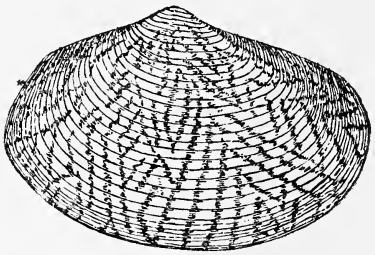

Fig. 63.—*Sunetta meroe* L.

The True Cockles

The true Cockles (*Cardiidae*) are represented in Indian seas by several large and handsome species, notably the Asiatic Cockle (*Cardium asiaticum*) found on all sandy coasts. This cockle is thin-shelled and highly inflated, with the exterior sculptured with fine ribbing. In size it runs to two inches in length, the depth being appreciably less. The foot is very large, bent in the middle nearly at right angles; it is used for leaping and some species can jump a foot or more off the bottom. Unlike the thick-shelled and smaller cockle of European seas, none of the Indian cockles has any appreciable economic value, as they do not appear ever to occur in thickly populated beds. Several species are found in the Laccadives, including *Cardium australe, C. leucostoma* and *C. fragum*.

The **Holy-Water Clams** (*Tridacnidae*) are so called because of the use to which their immense ribbed valves are put in Roman Catholic churches in Europe and elsewhere. They grow to a larger size than any other bivalve, the shell attaining in exceptional cases a weight of over 500 lb. The valves interlock at the edges and each is deeply corrugated, folded into a few very bold ridges radiating from the umbo. The substance is white and procellanous, very thick and strong. The mantle edges exhibit an exceptional condition among bivalves; they are united throughout their entire length apart from three restricted openings, a branchial, an anal

and a pedal; through the last named, a massive byssus passes. A single adductor of enormous power controls the opening and closing of the valves. The smaller species usually live in burrows in coral reefs; others, often of great size, lie attached by their byssus to reef rock, often in extensive beds, on flats where the corals are either dead or inactive in growth. Stories are told of the great power of their grip and pearl divers in the South Sea dread as one of the greatest dangers of their calling, the possibility of setting a foot within the gape of a giant Tridacna.

In Indian seas we find them here and there on the coral reefs of the Gulf of Mannar; in the Laccadives they are especially abundant. To see the gorgeous colour of the mantle frilling as these molluscs lie with their shells agape in a clear pool is one of the many wonders of a coral reef; the gaudy hues of Joseph's coat were dull and drab compared with the sparkling loveliness of the iridescent blues and purples and oranges of the mantle filaments and folds protruding from between the open valves.

The Chamas

The next family, the *Chamidae,* has several essential morphological features common with the cockles and tridacnas, but unlike them its members live their adult life with one valve, the left, cemented to stones, corals and shells. The Indian Chamas are all small and may be taken for Thorny Cockles (*Spondylidae*) if the form of the hinge be not noted. In Chama the ligament is external and not in an interior pit and there are fewer hinge teeth—two in one valve and one only in the other. The regular disposal of the spines and the brilliant, florid colouring of the Spondyles are also absent.

The Garids

Of the *Garidae*, the lovely *Soletellina diphos* and *S. atrata* are the best known representatives on our coasts. The former is a long, oval, purple-coloured shell, rounded at front and narrowed behind to a somewhat pointed form; in life the purple tint is masked on the exterior by a smooth, dark yellow periostracum. In length it grows to five inches; this large size and the unusual colour of the shell render it conspicuous when thrown up on the beach. It is fairly common on the Coromandel coast while on the Konkan coast its place is taken by the equally common *S. atrata.*

Like most other members of the family *Garidae*, these mauve or purple species have extremely long siphons, each separate from the other. They live buried deeply in the sand, keeping communication open with the water above by means of these siphons which open level with the sand surface. When retracted these long siphons occupy much space within the valves; this space is indicated by the deep bay marked upon the hinder part of each valve —the pallial sinus. Several other species, chiefly of the genus *Gari*, are found in Indian waters; they are all much smaller than *Soletellina diphos* (e.g. *Gari pallida* found at Bombay) and instead of a pointed posterior end it is usually blunt or sub-truncate.

The Razor-Shells

The Razor-Shells (*Solenidae*) are long scabbard-shaped shells living in deep burrows in sandy bays. The foot is enormously developed, cylindrical in form, mobile and protean in action, capable of swelling out with lightning rapidity or thinning to a point adapted to the easy penetration of loose sand. At low tide the slot-like openings of their burrows are often exposed and, as we walk near the edge of the sea, little jets of water shot up here and there bespeak the retreat to the bottoms of their burrows of Razorfish that have sensed the vibration of footsteps upon the sand. It is difficult to dig them out, so fast and so far do they burrow; even if the fingers do succeed in seizing one by the uppermost or posterior end, it is hard to pull out a large individual for the foot can be expanded at the lower end to form a living bulbous anchor after the fashion of the mushroom anchors used for the mooring of buoys. Sometimes they hold on so tightly that the swollen end is broken off and left behind.

Most Indian species are small in size as *Solen corneus*, *S. truncatus* and *S. brevis*, the last two common at Bombay.

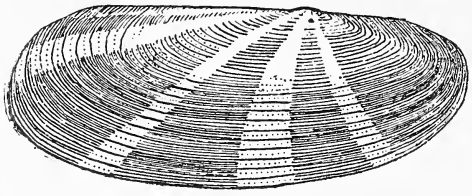

Fig. 64.—The Sunset-shell (*Siliqua radiata* L.).

A very pretty relative of the Solens is the **Sunset-Shell** (*Siliqua radiata*). The shell is smooth and oblong and is marked distinctively by broad, wedge-shaped bands of mauve, radiating from the umbo. It is found on sandy shores in company with the more deeply tinted Soletellina; the occurrence of this peculiar colour in molluscs that live completely buried in sand is evidence that colour may often be of no significance in the economy of an animal save as the visual evidence of the presence of waste excretion. A curious oblique ridge or rib extends on the inner surface of each valve from the beak across the shell towards the ventral margin. In no other family is any similar structure seen.

The Borers

The habitat and shell design of the Borers (*Pholadidae*) exhibit peculiar features of great interest. In countries where the coastal rocks are comparatively soft, these molluscs excavate burrows in the same style as Date-shells do in coral. In India the Borers are seldom found in rock—our gneiss and schist are too hard for them; instead they affect stiff peaty and clayey deposits where boring is comparatively easy. The finest instance of this is on the north coast of Palk Strait, to the west of Point Calimere. Here a stiff clayey deposit is found; the conditions must be ideal for boring and food must be plentiful, for here a truly magnificent shell, the Oriental Borer (*Pholas orientalis*) is abundant and of a larger size than any European species. A length of 4 to $4\frac{1}{2}$ in. is common. The shell is beautifully proportioned; long and tapered behind, snowy white in colour, papery in appearance, brittle but exceedingly hard. The surface is covered with prickly sculpture, rasp-

like in arrangement. There is no true hinge and the ligament has given place to an accessory shell plate. More peculiar still, the dorsal edges of the valves have grown *outwards* in such a manner as to become reflected over the umbones, protecting them from damage. These *umbonal* plates are further strengthened by supporting pillars and plates, dividing the space under these outgrowths into a number of minute chambers. Within each valve a short stout rod projects inwards from the edge of the umbonal cavity. The Pholads appear to excavate their burrows largely by patiently rasping down the walls by the semi-rotation of their shell, first to one side and then to the other. The foot takes part also in the operation of boring.

The valves gape at each end. From the hinder one project the siphons here united externally into a single organ, tubular in form. The extremity, slightly bifid, projects beyond the mouth of the burrow when the animal is feeding. The long narrow gills extend into the inhalant siphon.

A smaller species, *Pholas bakeri,* is sporadically distributed from Bombay southwards to Malabar and thence into the Gulf of Mannar. Members of an allied genus, *Martesia,* bore into floating wood; *M. striata* is a common Indian species.

The Ship-Worms

The Ship-Worms (*Teredinidae*) are still more specialized for boring but they confine their attention entirely to wood. The body is long and worm-like, the siphonal tubes being of extraordinary length, united throughout the greater part of their course. The shell is small and globular, covering only the thick anterior end where the visceral organs are situated. The tiny valves show resemblance in essential features to those of the Pholads, especially in the presence of a calcareous spur in each umbonal cavity; Teredo has evidently descended from a Pholas-like ancestor, suffering extreme modification in its successful attempt to perfect its form to a burrowing habit. The body in some of the common species may reach a length of a couple of feet or more, with a diameter of about a quarter of an inch. As it starts making its burrow when quite tiny and never quits it, the aperture is minute. The burrow is lined with a calcareous tube, not connected in any way with the body of the Teredo but deposited from a secretion poured out by certain glands. Contrary to the general belief, Teredo does not feed upon the wood it excavates.

Ship-worms are extremely destructive to timber, especially in the tropics; unless protected by metal sheathing or some special composition, woodwork under water becomes riddled with the multitude of their burrows within a few months. The hardest wood is not immune. I have seen ironwood piles completely destroyed and reduced to a mere shell of honey-combing at Tuticorin. Deal-wood perishes within a few weeks. Their ravages cause constant anxiety to the owners of small coasting craft and fishing boats. The accepted Indian method of combating the shipworm's destructiveness is to haul the vessel ashore or else careen her, and after drying as thoroughly as possible, to daub the underwater parts

with a mixture of chunam, dammar and oil. Canoes and small boats being easier to handle are hauled ashore at frequent intervals and have their bottoms smeared with rancid fish-oil of an odour warranted foul enough to disgust any ship-worm larva that comes near. Sometimes an Arab sailing vessel has been neglected too long and has become riddled below the water line with Teredo tunnels. The owner will then lay her up during the Monsoon at any handy west coast port and engage carpenters to endeavour to repair the damage; such a vessel I have seen with every visible hole plugged with a wooden spike about four inches long; when all were inserted the bottom looked like a giant porcupine for the projecting ends of the hundreds of spikes were not cut off till all were in. Such a repair is obviously no cure but it permits the craft to be sailed home when good weather returns.

A short length of the siphon tubes is free at the hinder end and at the point of junction of these free ends with the long, united siphonal region are situated a pair of tiny pallet-like limy plates supposed to be of use in protecting their owner against the intrusion of any unwelcome visitor. These pallets may be likened in function to the operculum of a gastropod.

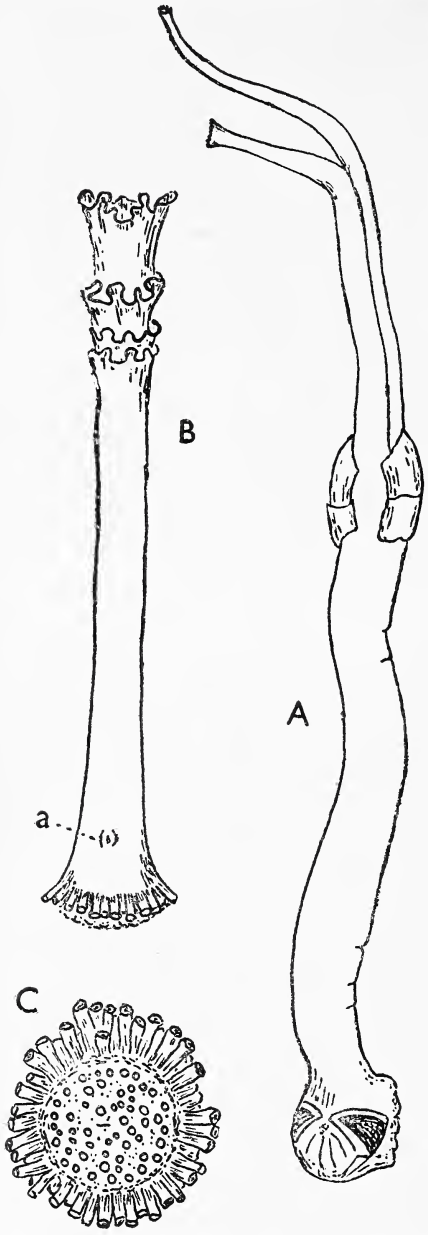

Fig. 65.—A, a Ship-worm (*Teredo*), extracted from its burrow. Note the pair of pallets above the origin of the siphons and the vestigial shell-valves embracing the rounded 'head'. B, Cylinder of a Watering-pot Shell (*Aspergillum javanum* Lam.), showing the frills around the siphonal end of the tube and the circlet of short tubules at the anterior end; *a* indicates the remains of the larval shell embedded in the wall of the cylinder. C, face view of the perforated 'rose' at the lower (anterior) end of the cylinder.

Watering-Pot Shells

Last of all and more degenerate and quite unlike typical

bivalves are the Watering-Pot Shells (*Clavagellidae*). They are common on our sandy shores, washed up after storms; they may also be found at very low spring tides embedded upright in the sand. In form their habitation is a short, stout, brittle calcareous cylinder about three inches long with several delicate upstanding frills round the open upper end (Fig. 65, B). The lower extremity is closed, slightly convex, perforated with holes and surrounded with a number of short open-ended tubes—the whole suggestive of the rose of a watering-pot or can, whence the name (Fig. 65, C). When first seen the impression is that the short open cylindrical tubes fringing the 'rose' are the broken bases of rootlike tubes; this is not the case. That the creature is a bivalve is proved not only by a study of the soft parts of the body but by the presence of a tiny but perfect bivalve shell (*a*) embedded in the surface of the main tube just above (posterior to) the rose. The larger structure, the frilled cylinder, is a secretion of the siphons.

A common Indian species is *Brechites dichotomus* or *Aspergillum dichotomum* as it was formerly called.

Class V.—CEPHALOPODA

The Cephalopods are so called because the foot, here divided into a number of tentacle-like arms, is attached apparently to the head. The body is a muscular sac containing the viscera and gills. In many forms an internal 'bone' or 'pen' stiffens the body in a manner comparable with the backbone of the higher animals. The head, joined to the body by a narrow neck, is furnished with a pair of large eyes, perfectly constructed optically but evolved by quite a different line of development to that of the vertebrate eye; although vastly larger its optical mechanism is on the same basic plan as that of the cephalic eyes of Strombus and other typical gastropods.

The arms, either eight or ten in number, arise in a circle at the forward end of the head. Except in the case of the Pearly Nautilus these are armed with a large number of suckers, enabling the animal to cling tenaciously to any object at will. Each sucker is a round disc with a little bulbous cavity at the centre that enables the creature to work the sucker apparatus like an air-pump; the vacuum created causes the sucker to adhere by atmospheric pressure and this continues so long as the central intelligence controlling the muscles working the sucker's piston maintains them in a state of tension. The mouth, situated in the centre of the circle of arms, is armed with a horny parrot-like beak, capable of rending its prey; in large species it is powerful enough to inflict severe injury upon man.

The class is divided into two sections according as the number of gills is two or four. Those characterized by the latter number were predominant in former geological times but to-day the Pearly Nautilus is the only existing Cephalopod with four gills. The two-gilled section is in turn divided, according as the arms are eight or ten, into the Octopoda and the Decapoda. The common Octopus and the Paper Nautilus (*Argonauta*) are types of the former; the Cuttlefishes, Squids or Calamaries and the curious little Spirula are the best known representatives of the other.

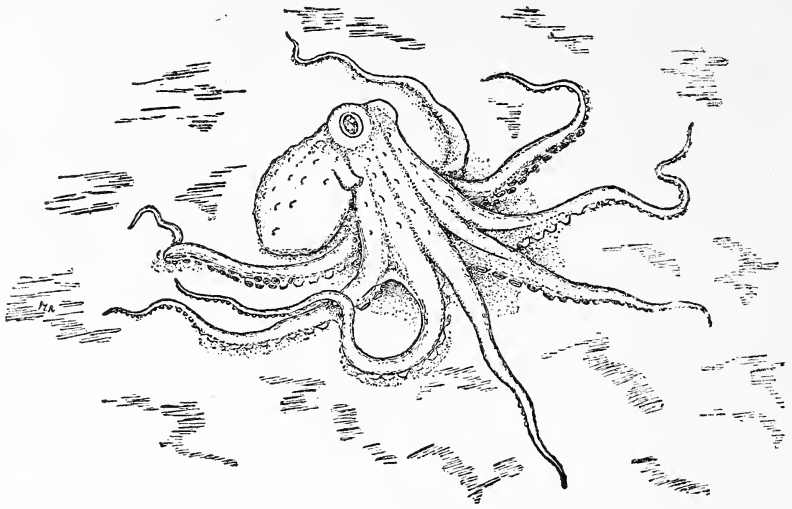

Fig. 66.—A small Octopus crawling over the bottom.

The Octopuses

The Octopoda have neither internal nor external shell, with the partial exception of the Paper Nautilus where the female forms an extremely fragile and transparent shell in which she brings forth and shelters her eggs. Some Octopods attain a large size and mythological stories tell of huge individuals that have seized men from boats —stories founded on the immense size of deep-water individuals occasionally risen from the depths, found floating or thrown ashore. In our Indian seas the largest I have seen, Herdman's Octopus (*Octopus herdmani*), has a body less than the size of the closed fist, with arms $2\frac{1}{2}$ feet long when fully extended. The Octopus is by far the most intelligent of the mollusca; it seems an absurdity to class it with snails, chanks, oysters and ship-worms. In one sense the name of Devilfish sometimes given to it both in English and in Tamil (*pey kanavai*) seems justified. If several Octopods be watched in captivity and if they be at home in their surroundings, the cleverness of the creatures in stalking their prey and their cruel rapacity in tearing their victim into pieces when caught are uncanny and devilish. I have watched an Octopus on the prowl sliding stealthily over the bottom with all the skill of a high intelligence; every bit of cover is made use of and even the colour of the bottom is imitated for concealment. Passing over yellowish sand the dark body tints of the Octopus fade away and there is nothing but a slight pulsation to betray its presence. Anon it crawls over a mass of brown weed—dark tints come back in a flash and once more the animal is indistinguishable from its background. This ability to make lightning changes in its colour disguises is due to the colouring matter in its skin being in little sacs controlled by tiny sets of radiating muscle fibres. If the muscles contract the pigment spots grow and expand; if they relax, the spots close to pin points and a greyish yellow pallor suffuses the body.

Crabs are the favourite food of the Octopus, but they will also open bivalves, and fishes are occasionally caught by the cruel snake-like sucker-beset arms.

Wherever sea-bottom growth is luxuriant; wherever corals, gorgonids, and pearl oysters abound; wherever a tangle of sea-weeds, sea-grass, or of hydroids be found as in the Beyt Channel in the Gulf of Kutch, there Octopods thrive and multiply. More than anywhere else they love the crab-tenanted weedy shallows of Palk Bay where great use of them is made by the line-fishermen who esteem them their best bait, for their flesh is firm, not easily pulled off the hook, and of an odour tempting beyond measure to the fish sought after. The Octopods so used are quite small and work on their specific differences is greatly wanted. To capture them long lines are prepared having hundreds of short branch lines tied on at intervals of from five to six feet. To each of these side lines a large *Lambis* shell (usually *L. lambis*) is attached, the apex and the fingers being first broken off. These lines are sunk overnight on the weedy beds which these Octopods frequent in company with the Blue-clawed Swimming Crab, *Neptunus pelagicus*. The next morning when the lines are hauled, many of the shells are tenanted by small Octopods that had sought concealment therein. The average number of shell-traps used on a devilfish long-line averages upwards of 800, made up of a contribution of several short lengths from each of the five men manning each fishing canoe.

The men credit these little Octopods with a great deal of sagacity; amongst other clever tricks attributed to them is that when they enter an empty shell, they are careful to block the entrance with a shell or a piece of stone as a screen against their enemies, the big swimming crabs.

Often on the pearl banks I have come across the same kind of small Octopod hiding in empty pearl-oyster shells, and in others it is not uncommon to find the inside of one valve covered with a closely set layer of their tiny colourless eggs. The large species are scarce in comparison with the small ones having a body of a size varying from that of hazel nut to that of a walnut. All are provided with an ink-sac and a favourite trick to cover escape when pursued is to eject a cloud of inky fluid from this sac; this diffuses at once and forms a dense dark cloud—a 'smoke screen'—covering their movements.

Of the ten-armed Cephalopods, the Squids or Calamaries and the Cuttlefishes, several species are common in Indian waters. The Octopus has solitary habits and frequents rough bottom where he is able to ambush his prey; not so the Decapods. The latter have far less intelligence and instead of quartering the bottom in quest of prey, they swim through the open sea in shoals, often of immense numbers.

The Squids

The Squids (*Loligo*, *Ommastrephes*, etc.) are the most active of the Cephalopods; to speed through the water their body is long and torpedo-shaped, armed with a powerful triangular fin on each

side. The Octopus on occasion is able to dart swiftly backwards by expelling water from the gill chamber through a siphon on the under side of the body. The Squids also have this power but their caudal fins are so greatly developed that swimming is their customary mode of locomotion. A shoal of these elegant creatures in flight through the water is an entrancing sight never to be forgotten.

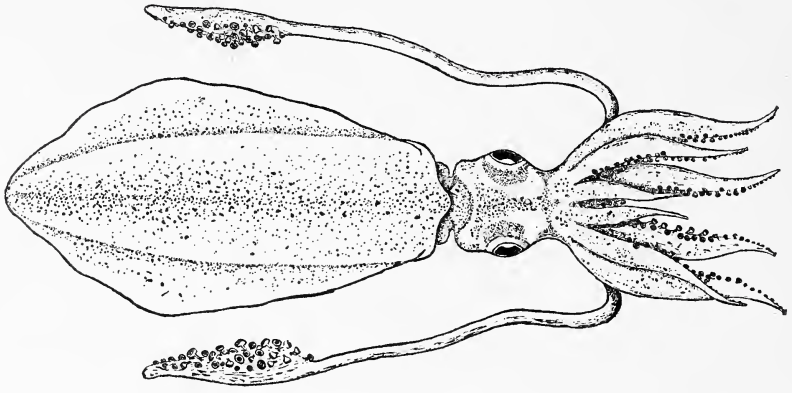

Fig. 67.—The Common Squid (*Loligo*).

Unlike the arms of the Octopus those of the Squids are short and stumpy with the exception of the extra two—the tentacular arms—which are very long; instead of the suckers being distributed throughout the entire length as usual with the others, they are restricted to a broad pad-like swollen region at the far end. Each of these long arms is retractile into a pouch on either side of the head; they are used to seize their prey when at a distance. An internal support, the pen or *gladius,* is present in the dorsal region. It is a thin, light, nearly transparent horny structure, with a stiffening rib down the centre on one face.

Alike with the Octopus and the Cuttlefishes, the Squid has an ink sac for defence. In the presence of danger the contents are discharged as an inky cloud; often indeed has it need to employ this protective device for it is a favourite morsel with most large fish and with certain of the large cetaceans; the sperm-whale feeds greedily upon the large species that inhabit the deeper horizons of the oceans.

Squids are abundant in all our coastal waters during the local fair weather periods but it is only in the deep embayments, such as the Gulf of Kutch, parts of the Gulf of Mannar and in Palk Bay that they haunt the inshore waters in great shoals. Probably they are most common in Palk Bay and Strait. Shoals appear in the shallows off Rameswaram Island about the month of April and during the height of the S.-W. monsoon the shoals reach their maximum. At that time they seem to be made up of immense assemblages of individuals gathering under the lee of the land, partly to feed upon the smaller fry that seek shelter there from the violence of the monsoon and partly to deposit their egg capsules (Fig. 68) among the weeds growing luxuriant in the place favoured.

A notable fishery is pursued in this region for their capture. Two methods find favour, the one a wholesale netting in which thousands may be caught at one haul by means of a great seine net having a close-meshed net in the centre with wing ropes thickly beset with palm leaf strips to function as scare-lines; the other method is where the skill of the individual fisherman is exercised in catching the Squid singly with the aid of a long-handled jigger. To use this the fisherman builds a primitive machan in shallow water; it is usually nothing more than a stout-forked jungle post set fork upwards; on a crossbar joining the forks the man perches himself precariously and from this stage awaits the approach of a female Squid intent upon depositing her candle-shaped egg-capsules among the pile of leaves which the man has placed on the sand around the base of his lookout. Sometimes the structure is made more stable by using four posts carrying a square platform. The jigger is a pole 12 to 15 feet long armed with 5 or 6 hooks set grapnel-fashion around the working end.

Whatever part of the catches is not sold fresh—the demand is considerable—is split and sun-dried; this makes a clean and attractive product, sold at inland markets at about Rs. 3 per 100.

Cuttlefishes

Cuttlefishes (*Sepia* spp.) have a large, fleshy, flattened body bordered by a narrow frill-like fin on either side, a head furnished

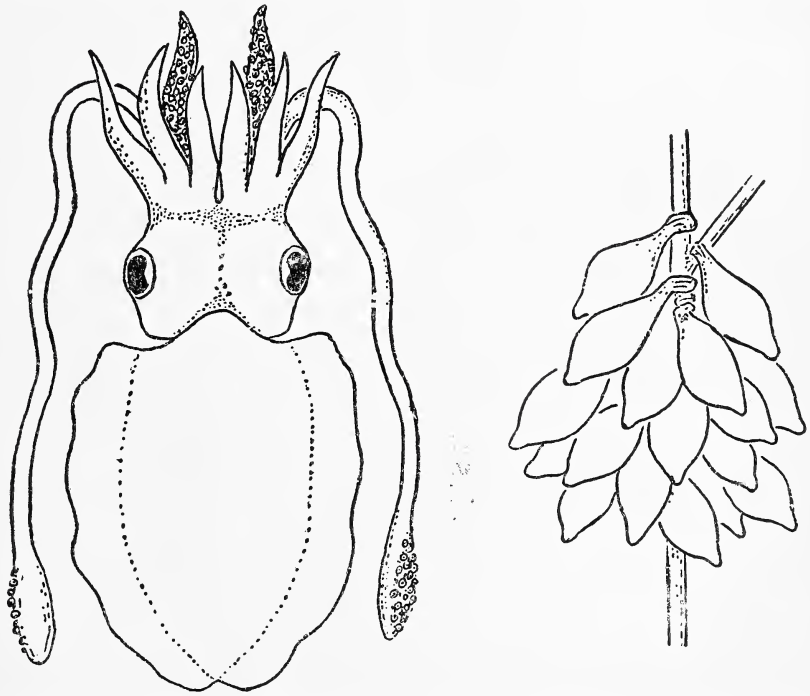

Fig. 68.—A typical Cuttlefish (*Sepia*) and a cluster of its black, grape-like eggs. ×½.

with two great goggle eyes, and beset with tentacles of two kinds of the same general character as in the Squids (Fig. 68); instead of the long horny pen found in the latter, the Cuttlefish has an internal support in the form of a broad, stoutly built 'bone', composed of fine calcareous laminae enclosing air spaces. This cuttle-bone has value for rubbing down paint in fine coachwork and a minor industry on certain parts of the Indian littoral is the collection of these bones during the monsoon when they drift ashore, sometimes in great numbers. The brown pigment called 'sepia' is another minor commercial product obtained from the Cuttlefish and its relatives; the rich brown pigment, when genuine, represents the dried and pulverised contents of the ink-sac of Cephalopods.

Palk Bay fishermen cherish the erroneous belief that cuttlefish cast their bones annually in February and March, the season when the bones are thrown ashore in quantity.

A small and very pretty Cephalopod is *Sepiola*, a stout-looking form seldom exceeding $1\frac{1}{2}$ inch in length. Its distinguishing feature is the presence of a rounded, paddle-like fin on each side of the rotund little body. It lurks in little pits on sandy bottom, buried up to the eyes, watchfully alert for any small crustaceans and tiny fishes that may wander incautiously within reach of its two long tentacular arms.

Spirulas

The last of the ten-armed forms is the aberrant *Spirula* of wide oceanic distribution within the tropics. Wherever be its haunts when alive, there it must exist in great profusion for multitudes of its curious, loosely coiled 'ram's horn' shell are to be found on every beach in the Pacific and Indian oceans after a spell of long continued onshore winds. Only a very few specimens of the living animal have ever been found and absolutely nothing definite is known of its habits. From study of the soft parts three species are believed to exist but the shells of all are identical.

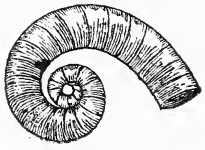

Fig. 69.—Shell of *Spirula peronii* Lam.

The animal has the appearance of a very small long-bodied Sepiola bereft of its fins and measures about $2\frac{1}{2}$ in. in length. It has the usual eight short arms and two tentacular ones. A terminal sucker or pore exists at the posterior extremity of the body and it has been surmised that this enables it to anchor itself to a rock or other stable object.

The shell of Spirula like the bone of the Cuttlefish is an internal structure; it is located in the hinder region of the body and has the form of a loosely coiled tubular cylinder, snowy white without, nacreous within. At frequent intervals throughout its length it is divided into short chambers by thin concave partitions as in the *external* shell of the Pearly Nautilus next to be described. As in the latter, each partition is traversed by a narrow tube, the siphuncle. This tube passes close to the inner wall of the whorls, whereas in the Nautilus it passes through the centre of the partition walls.

The Pearly Nautilus

Last of the Indian Cephalopods but again represented solely by empty shells drifted ashore, is the four-gilled *Pearly Nautilus,* the sole living representative of a great host of strange molluscs that flourished exceedingly during the Palaeozoic and Mesozoic periods. The Ammonites, though closely related in shell form are, however, not so nearly akin as the earlier straight-shelled *Orthoceras.*

Though the shell of Nautilus like that of Spirula is one of the familiar objects of tropic beaches, nothing was known of its habits until a few years ago. Dr. Willey was one of the first to throw light on its life-history and to watch it in captivity. The seas around the islands of the Western Pacific are its headquarters; there in moderate depths Willey was able to capture numbers by the simple expedient of sinking wicker traps to the bottom. He found Nautilus to be gregarious and nocturnal, crawling over the bottom in troops at night time in search of the crabs and shellfish on which it feeds.

The figure shows its ordinary attitude when crawling. It is also able to swim after the usual manner of Cephalopods. The earliest specimens captured were taken floating or swimming on the surface. In this position the numerous tentacles, 60 to 90 in number, which here take the place of the arms in other cephalopods, are arranged in a radial manner around the mouth and this accounts for the old-time description given of it when seen floating on the surface as 'a shell with something like a cauliflower sticking out of it'. These tentacles are prehensile and are given off from lobes of the foot surrounding a mouth armed with a beak which is solid and calcified instead of horny as in other cephalopods.

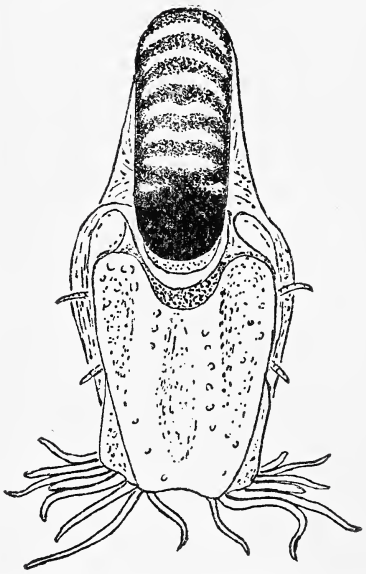

Fig. 70.—The Pearly nautilus in the attitude of crawling. (After Willey.)

A dorsal lobe of the foot forms a thick and strong hood for the protection of the whole animal when withdrawn into the great roomy terminal chamber of the shell. Unlike typical members of the class Nautilus has no ink-sac.

The shell is a pretty object often thrown ashore during monsoon storms. The size is considerable, often reaching 4 to 5 inches in diameter. It is a discoidal shell, coiled in one plane, and divided by concave septa into a large number of chambers, increasing in size as they approach the open terminal chamber; in this the whole body of the animal is lodged. The chambers are connected by a narrow siphuncular tube as in Spirula; in life a delicate membranous tube passes from the hinder end of the animal backwards

through the siphuncle. With increase in size the Nautilus periodically finds the body chamber too small, so lengthens and widens it in front, while behind it shuts off the hinder portion of the chamber by a new transverse partition. The chambers are filled with a nitrogenous gas; this has value in lightening the shell and is useful in adjusting the weight of the body to the particular need of the moment. It is in effect a hydrostatic apparatus.

The interior of the shell is pearly as are also the septa, while the outer layer is porcellanous, barred irregularly with broad wavy bands of reddish brown upon a whitish ground.

The end.

THE INLAND FISHERIES OF KODINAR[1] IN KATHIAWAR

BY

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(*With a plate*)

(Communicated by Dr. S. L. Hora, D.Sc., F.N.I.)

Introduction

In a recent article in this *Journal*[2], one of us (T. V. R. Pillay) gave a detailed account of the Marine Fisheries of Kodinar. Being a very important centre of sea fishing, the inland fisheries of Kodinar have not attracted much attention so far, even though the State derives some revenue by periodically leasing out the fishery of the Somat river. Investigations were conducted by the authors during 1947-48 with a view to collect data regarding the inland fishery resources of the taluka and examine the possibilities of their development; and this paper embodies the results of these investigations.

Kodinar is a pocket of Baroda State territory 207 sq. miles in area, in South Kathiawar, bounded by the Arabian Sea on the south and Junagadh State territories on all the other three sides. Kodinar enjoys a very good climate, the heat being tempered much by the delightful sea breezes. The average rainfall is 30″, while the highest is 54″. The land which consists generally of a plain of fertile soil, is irrigated by the Shinghoda, Somat and Shingavadi rivers. There are two other seasonal rivers also *viz.*, Gome and Rupen. During the rainy season all the rivers and ponds get flooded but they dry up partially or completely during the summer drought. The coastal regions abound in creeks and backwaters and in certain localities, the general aspect is that of a network of creeks with tidal swamps in between. The types of inland waters, important from the fisheries point of view in the taluka are (1) the creeks and backwaters, (2) rivers, and (3) village ponds.

Creeks and Backwaters

In the absence of any big rivers or lakes, the creeks and backwaters form the most important type of inland waters in Kodinar. All the year round, fishing is carried on in these waters, and during periods when sea fishing is closed due to rainy or other unfavourable weather conditions there is a natural intensification of activities. Kotda and Madhwad are the two important centres of this type of fishery. The wide and shallow backwater, lying east of Kotda and separating the Baroda State territories from that

[1] An abstract of this paper was published in the Proceedings of the 36th Session of the Indian Science Congress, Allahabad, Part III, 1949.

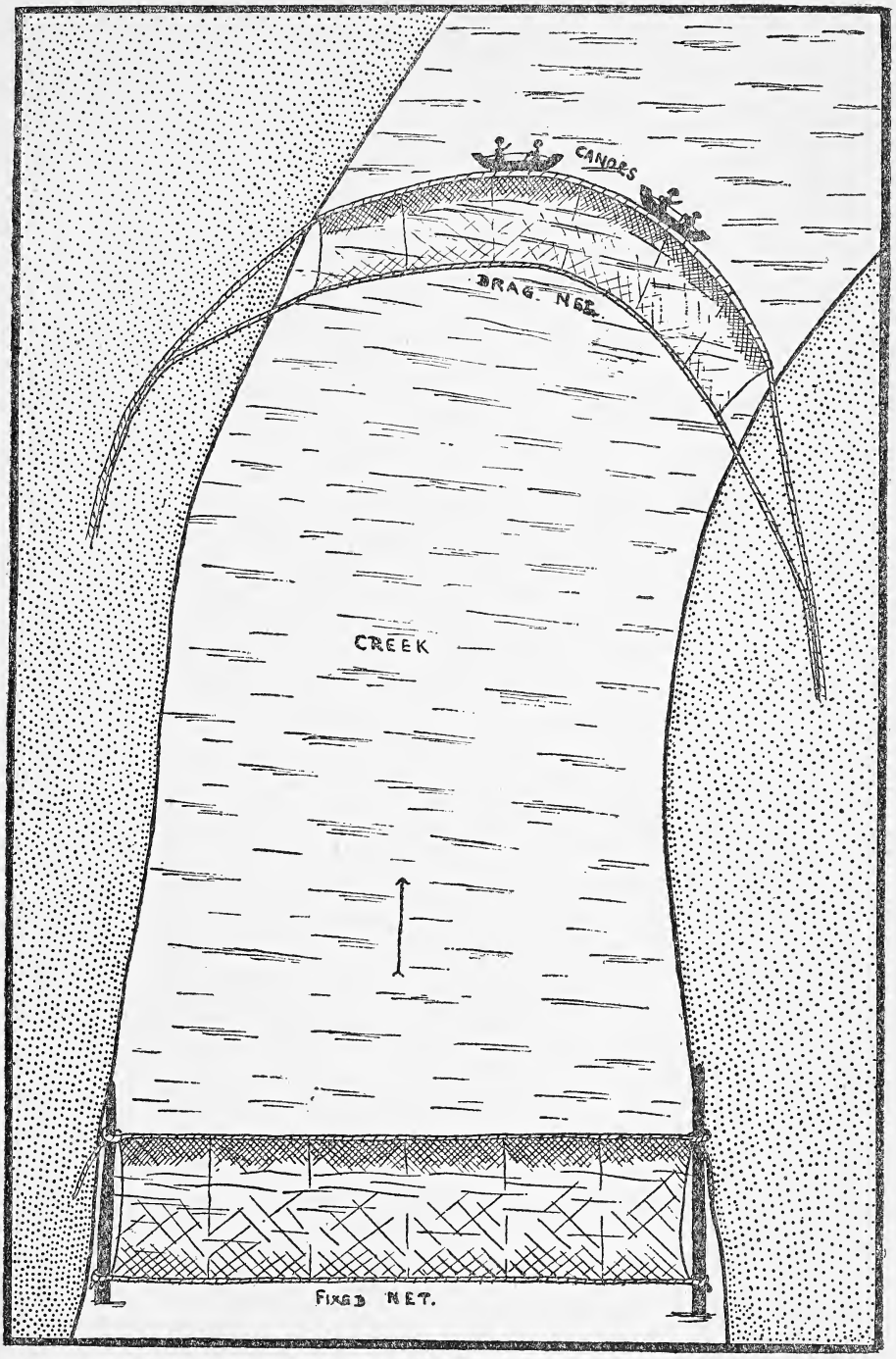
[2] *Journ., Bomb. Nat. Hist. Soc.*, **48**, (1)—1948: pp. 47-61.

of Junagadh, is the richest among them. This area, right from its mouth opposite Diu island to Chikkhli and Phatalbara affords lucrative fishing and is fished by the Kharvas and Kolis of Vanakbara and Kotda.

Fishing is generally done from dug-out canoes in deep waters, and by wading in shallower regions. The nets used are of three types, *viz.*, cast nets, drag nets, gill nets and traps. *Cast nets* are mainly of the unstringed variety and are operated from the banks in creeks and from dug-out canoes (*Tindias*) in backwaters. The mesh of this net generally increases from 1/2" square at the apex of the cone to 1" square at its base. The weighted periphery has attached to it a large number of short cords which are tied at points approximately 2½ times its length. Thus a deep peripheral pocket is formed for the net. When thrown, the net forms a cone over the enclosed area and the hauling cord attached to a central point at the apex is slowly drawn up. The fish in the area is then gravitated into the peripheral pocket as the net is hauled up. The cast net is employed for the capture of all kinds of small fish available in these waters.

There are two types of drag nets operated in the local creeks and backwaters, and they are the *Choklo Jal* and the *Vedi Jal*. *Choklo* is the simpler of the two and consists of a more or less square piece of hemp netting (20-25 ft. long and 20 ft. broad) strung on a bamboo pole at each end. Two fishermen are required for the operation of the net and each holds one side and drags along the narrow creeks for some distance. Then it is skilfully hauled up so as to capture the fish driven along by dragging. The main constituents of the catches are Talar (*Engraulis* spp.) and Boi (*Mugil* spp.).

Vedi Jal is a bigger edition of *Choklo* and consists of several pieces of such netting tied end to end. The number of pieces used and the resultant length of the whole net depends upon the width of the backwaters in which they are operated. The main object is to fence up the areas and drag up and encircle the fish in the locality. First a straight fence is constructed across the backwater by tying together a suitable number of net pieces and fastening them at both ends to two bamboo poles driven into the sandy or muddy bottom. Then the dragging net is paid out at a suitable distance across the backwater. The net has a thick coir or hemp foot rope, the weight of which makes it sink down vertically. There is also a similar head rope, and this is kept raised up by the fishermen who follow it in dug-out canoes (see plate). The canoes may be one, two, or more according to the length of the net. The free ends of the head and foot ropes are taken charge of by two parties of fishermen and they drag it along towards the fencing. Dragging is always done against the current. As the dragging net draws near the fencing, the part on one bank crosses over to the other forming a ring. The ring is slowly made smaller and then the net is hauled up in such a way as to capture all the fish in the ring. Where the backwater is too wide to do dragging from the banks the fishermen do so from dug-out canoes. The *Vedi Jal* is generally operat-



THE OPERATION OF THE "VEDI JAL" – DIAGRAMMATIC.

ed during the monsoons and the catches consist mainly of Netla, Talar (*Engraulis* spp.) and small Boi (*Mugil* spp.).

The gill net in this area is the *Khandari Jal* and Pillay (1949)[1] has described the net and the mode of its operation. It is a single-piece wall of cotton netting 75 to 80 feet long and about 4½ feet high, strung on a half inch thick cotton head rope and a thinner foot rope of the same material. It is buoyed up by means of thin circular pieces of light wood or pith about 2″ in diameter and ½″ in thickness, tied to the head rope half a foot apart. During day time at high tide, the net is set in the form of a wall across the mouth of the creek from a tender canoe. The number of fishermen engaged in working the Khandari jal is two or sometimes three. Generally one of them will be a boy who takes his initial lessons in fishing in these inland waters before venturing into the open sea. After paying out the net, the tender canoe is rowed about in front of the net, and one of the fishermen beats the side of the boat with a wooden stick, so as to drive the fish towards it. The frightened fish rush or leap against the net and get gilled therein. A good many find themselves landed inside the canoe in their frantic efforts to escape. The catches mainly consist of Boi (*Mugil* spp).

Traps are seldom used by fishermen in this area. The only instance of such a contrivance was observed to be employed by the Kolis of Velan in the narrow creeks for capturing small mullets. An account of this is also included by Pillay (op. cit) in his paper 'Grey Mullet Fishing in Baroda State'. At low tide, the creek is bounded off at its narrowing portion and the bund is camouflaged by marsh plants. A 3 foot gap is left in the middle of the bund and a rectangular piece of bamboo patta 3 ft. × 2 ft. is placed in this gap in a slanting position. The water from the creek flows over the 'patta', which acts as a sieve, and all fish brought in with the water, are either stranded over it or caught into one or two baskets kept behind.

The following fishes were collected and identified from these waters so far.

No.	Vernacular name		Scientific name
1	Taladi	...	*Clupea fimbriata* (Cuv. & Val.)
2	Netla, Talar	...	*Engraulis purava* (Cuv. & Val.)
3	Vam	...	*Hemirhamphus reynaldi* (Cuv. & Val.)
4	Vam	...	*Tylosurus strongylurus* (V. Hass.)
5	Vekhu	...	*Serranus lanceolatus* (Bloch.)
6	Hajamdo	...	*Therapon jarbua* (Forsk.)
7	Kankri	...	*Gerres filamentosus* (Cuv. & Val.)
8	Chanddi	...	*Scatophagus argus* (Bloch.)
9	Kakri	...	*Chrysophrys datnia* (Ham. Buch.)
10	Rawas	...	*Polynemus tetradactylus* Shaw.
11	Gullo	...	*Gobius criniger* (Cuv. & Val.)
12	Levta	...	*Boleophthalmus dussumieri* (Cuv. & Val.)
13	Boi	...	*Mugil borneensis* (Blkr.)
14	Boi	...	,, *oligolepis* (Blkr.)
15	Boi	...	,, *troschelii* (Blkr.)
16	Boi	...	,, *speigleri* (Blkr.)
17	Popicho	...	*Tetradon oblongus* (Bloca.)

[1] *Sci. & Cul.* **15**, (1)—1949 : pp. 20-23.

Besides these Jinga (*Penaeus carinatus*, and *Metapenaeus monoceros*) are also caught in fairly good quantities. A considerable portion of the catches consists of young ones and during the monsoons adults of some fishes that migrate to these waters for breeding are indiscriminately captured. Though it is difficult at present to enforce conservation measures here due to geographical and other reasons, possibilities of developing the fisheries of these waters by culture are great. The shallow marginal regions of the Chikkhli backwaters can be bunded off and made into ideal fish farms for the culture of mullets and other suitable marine or brackish water fishes on a large scale. Seed are available all through the year near by, and the incoming tides will solve the problem of fish food. The Chikkhli and Phatalbara creeks are also the abode of edible oysters (*Ostrea virginiana*). Conditions here are sufficiently suitable for the opening of edible oyster parks also. To the west of the village of Velan is a shallow and extensive backwater formed by a low bund across a narrow creek. This is locally known as 'Khari' because of the salt formed on its margins by solar evaporation. Though in summer season the salinity is a little high, during monsoons the water is all but completely fresh. During the rains, it fills up with fresh water; when full the surplus overflows and empties into the creek near by. The backwater is a favoured haunt of grey mullets and Hornell[1] (1948) and Moses in 1938[2] soon after the opening of the Fisheries Department in the State and again in 1944[3] recommended the conversion of this sheet of water into a mullet farm by raising the bund and providing a small sluice and emergency weir in the centre. The conversion of this backwater into a fish farm for the culture of oysters, pomfrets, mullets and Indian salmon, has been sanctioned by the Government and included under the schemes of Post-war development of fisheries in the State and will be started in 1950-51. The fry of mullets (*Mugil* spp.) are available in the adjoining creeks throughout the year and that of Indian salmon (*Polynemus* sp.) after the monsoons. But young ones of pomfrets (*Stromateus* spp.) have not been met with in these creeks or backwaters. The authors, therefore, conducted some experiments in the collection, transport and conditioning of these from the Madhwar Bay, where they occur in large numbers from December to April.

Young ones of the three types of pomfrets (*stromateus cinereus S. sinensis* and *Parastromateus niger*) are caught by the fishermen in fixed bag nets (*Gholu jals*). A good number of living fish could be collected by removing them as soon as the catches were emptied into the boat. But a majority of them were found fatally injured during the hauling of the net. The few uninjured specimens available were easily transported in earthern hundies to Velan in boats, and released into cement tanks. Then by slowly lessening

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[1] *Report on the further development of the Fishery Resources of Baroda State* by James Hornell (1918).

[2] *Annual report of the Department of Fisheries, Baroda State, for the year* 1937-38.

[3] *A Post-war scheme of Fishery Development in Baroda State* by S. T. Moses (unpublished) 1944.

the salinity of the water medium by the addition of fresh water, it was possible to acclimatize them to brackish and fresh water conditions within a week with only negligible mortality. But the greatest difficulty was experienced in obtaining live and uninjured specimens from the catches of fishermen. So, for the large-scale collection of young ones of this fish for cultural purposes some specialised method of fishing has to be devised. However during the investigations, young of *Stromateus cinereus* (2"-3" size) were found in the estuary of Shinghoda at Muldwarka; and this place which is only about 14 miles by road and about 7 miles by road-cum-sea route from Velan, will serve as a good source of seed supply for the farm.

RIVERS AND ESTUARIES

As mentioned elsewhere, there are five rivers: Somat, Shinghoda, Shingavadi, Gome and Rupen, flowing through Kodinar taluka and joining the Arabian Sea. But, of these, the last two will have some water in them only during the rainy months. Rivers Somat and Shingavadi form the western and eastern boundaries of Kodinar taluka.

These rivers hold some water throughout the year, but the water level is too low for large-sized fish to live. Somat and Shinghoda join the Muldwarka sea very near each other, and fishing is carried on in the estuarine areas of both, the Somat fisheries being leased out periodically. From the fishery point of view, Shinghoda is more important and the resources of this river were more thoroughly investigated.

Shinghoda starts from the Junagadh territory and flows through the central region of Kodinar taluka, almost splitting it into two halves. The river has very steep banks, so much so that, it is not of much use for irrigational purposes. During the monsoons the river is flooded, but in summer it dwindles down, leaving considerable portions of its sandy or gravelly bottoms exposed. The villagers cultivate seasonal vegetables on these fertile areas during summer. The water is fresh throughout excepting for 4 or 5 miles on the lower reaches near Muldwarka. Machiaras do fishing in the river at Kodinar where the water is always fresh by means of cast nets. The following fishes, and 1 species of prawn, viz., *Palaemon carcinus* Fabr., were collected and identified from the river near Kodinar.

No.	Vernacular name		Scientific name
1	Lunji	...	*Macrones oculatus* (Cuv. & Val.)
2	Denada	...	*Barbus stigma* (Cuv. & Val.)
3	Popri	...	*Barbus chrysopoma* (Cuv. & Val.)
4	Kharja	...	*Barbus hexastichus* McClellands.
5	Boi	...	*Labeo boggut* (Sykes)
6	Gullo	...	*Glossogobius giuris* Ham. Buch.
7	Dokas	...	*Ophicephalus punctatus* Bloch.
8	,,	...	*Ophicephalus striatus* Bloch.

Just after the rains, fry of *Labeo boggut* are seen in large numbers near about Kodinar city. Evidently they breed in the

small side streams in the locality. Adults of 8" to 8½" size are common in Shinghoda. In the absence of other major carps, this fish can be utilised for cultural purposes in this area.

The estuarine regions of this river are rich in fish life and this is the main source of fish supply in the Kodinar markets during the rainy season and on sea-fishing holidays. The men who do fishing here are Machiaras and the nets they operate are cast nets, and a kind of drag net known as *Jam Jal*.

The cast nets are of the type already described. The *Jam Jal* is very much similar to *Vedi Jal* in design. The main difference is that, it is provided with a series of floats and weights. As in the operation of the *Vedi jal,* first of all a fencing is made with a piece of rectangular netting 30 to 35 feet long, 16 to 18 feet high and of 1 to 1¼" mesh. The net is tied upright on wooden or bamboo stakes. The rope which is provided with iron sinkers, is either allowed to hang free or is fastened to the poles. Then about a furlong away, the dragging net is paid out. It is a single piece netting and is 60 ft.-75 ft. long, 16 ft.-18 ft. high and of 1"-1¼" mesh. The head-rope has tied to it several bundles of dry reeds which serve as floats. On the foot rope are strung, about 125 to 130 iron sinkers which together weigh about 4½ to 5 seers. This net is dragged along and hauled up exactly like the *Vedi Jal*. It is operated at the turn of the tide. The catches mainly consist of Mendley (*Coilia dussumieri*), Gandhio, Boi (*Mugil cephalus* and *M. olivaceus*.). The following fish were collected and identified from the estuary at Muldwarka

No.	Vernacular name		Scientific name
1	Ratdi	...	*Lutjanus malabaricus* Blkr.
2	Banga	...	*Hilsa ilisha* (Ham. Buch.) (Young ones)
3	Palli	...	*Chatoessus nasus* (Bloch.)
4	Mendley	...	*Coilia dussumieri* (Cuv. & Val.)
5	Hajamdo	...	*Therapon jarbua* (Forsk.)
6	Kutan	...	*Gerres oyena* (Forsk.)
7	Kaidi	...	*Chrysophrys datnia* (Ham. Buch.)
8	Timri	...	,, *berda* (Forsk.)
9	Pakhri	...	*Lethrinus cinereus* (Cuv. & Val.)
10	Patooda	...	*Stromateus cinereus* (Bloch.) (Young ones)
11	Gokhar	...	*Platycephalus carbunculus* (Cuv. & Val.)
12	Gulla	...	*Glossogobius giuris* (Ham. Buch.)
13	Gandhio	...	*Mugil cephalus* Linn.
14	Boi, Karoonji	...	,, *olivaceus* Day
15	Jib	...	*Pseudorhombus arsius* (Ham. Buch.)

The presence of young ones of *Hilsa ilisha* and *Stromateus cinereus* in the estuarine area, is of significance. The seas off Muldwarka afford a rich fishery in pomfrets and *Hilsa*. Though adults have not been observed ascending the river, the presence of young ones of different sizes tend to prove that they migrate into these waters and breed there. This estuary will be a good source of supply of pomfret fry for cultural purposes. Moses[1] (1938) proposed the opening of a Hilsa hatchery here and the sanctioned scheme, kept in abeyance during the war, was in-

[1] *Annual report of the Department of Fisheries, Baroda State, for the year* 1937-38.

cluded as an item of work in the plan of Post war Fishery development in the State and will be taken up in 1951-52.

PONDS

Almost every village in the taluka has a pond or two. But the majority of them hold water only for a couple of months after the monsoons. Fish life is very scanty in these ponds. The perennial ones are generally temple tanks and the religious susceptibilities of the villagers prevent fishing in these waters, even for survey purposes. So, the possibilities of pond culture for food production is extremely limited in Kodinar. However the irrigation tank of Pichvi which is in charge of the P.W. Department can be utilised for fish culture. Public health fish farming is probably the only activity of the kind, in which the cooperation of the villagers can be had. Being a malarious district, antimalarial fish culture has some possibilities here. The few larvivorous fishes available locally are not efficient enough and so exotic fish like *Gambusia,* which has an additional advantage in being viviparous, will have to be introduced for the purpose.

CONCLUSION

Among the inland waters of Kodinar, the backwaters offer the greatest scope for development and there are good possibilities for the establishment of extensive fish farms and oyster parks. The fish raised in these farms will have a ready market locally during the off-seasons and the excess can be railed from Kodinar to neighbouring towns like Dhari, Amreli, etc. Oysters will find a market in Bombay, and the country-crafts that now transport fish can suitably be utilised for their transport also.

The Velan Backwater Fish farm, when started will form the nucleus for cultural activities in this area.

The nets described above, are fairly well-adapted for operation in the inland waters of this area. The small mesh of nets like the *Vedi Jal* causes the destruction of large quantities of mullet fry. If they can be allowed to grow in the wild or cultured in farms, by enforcing legislation, it is bound to contribute considerably towards increased production.

ACKNOWLEDGEMENT

The authors are highly indebted to Dr. S. L. Hora for his kind suggestions and Dr. S. T. Moses, for help and encouragement in the preparation of this paper.

THE INDIAN CADDIS FLIES (*TRICHOPTERA*)

BY

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(*Dept. of Entomology, British Museum, Nat. Hist.*)

PART XI

(*With 13 plates*)

(*Continued from page 422 of this volume*)

SERICOSTOMATIDAE McLACHLAN—(*Continued*)

Goerodes Ulmer.

Goerodes Ulmer, Coll. Selys., fasc. 6, pp. 37-38, 1907.
Goerinella Ulmer, D. ent. Z., 75, pp. 68-70, 1915.
Crunobiodes Martynov, Ann. Mus. Zool. Acad. Sci. URSS., 28, p. 471, 1927.
Crunoeciella auct.

The genus is here based mainly upon characters furnished by the male genitalia. The species of *Goerodes,* in the male, show a considerable diversity in neuration, particularly in the anterior wing so that neuration should be considered as specific rather than of generic importance.

The insects are uniformly brown of varying shades. Basal joint of the ♂ antennae unbranched. Maxillary palpi ♂ generally two-jointed, shorter than the labial palpi, terminal joint, which is rather obscure, carrying a tuft of dark, much broadened scales. Spurs 2, 4, 4.

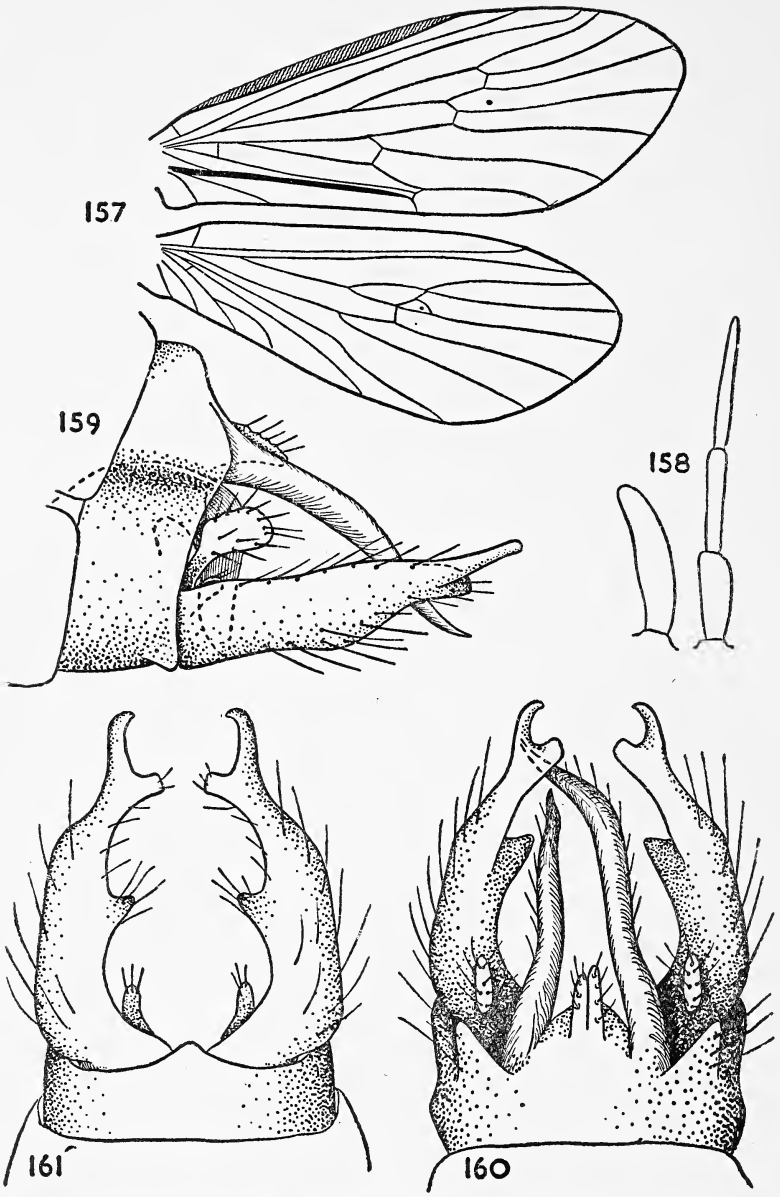
Genitalia ♂ :—All species in the genus conform in a production of the centre of the dorsal margin of the 9th segment in two pairs of processes, the outer usually appearing as asymmetric, sinuous and very stout spines, the inner varying in form; sometimes these processes are replaced by a plate or plates; the penis short and curved; inferior appendages always branched, the branches varying in number and form; they agree in all species in carrying a more or less erect branch, generally with a dilated apex, arising from the upper margin of the appendage towards the base, as seen from the side.

Genotype:—*Goerodes cornigera* Ulmer.

Goerodes ursina (Hagen) Fig 166.

Mormonia ursina Hag., Verh. Zool. Bot. Ges. Wien, 8, p. 484, 1858, ibid., 9, p. 208, 1859.
Goerodes ursina Ulm., Genera Insect., fasc. 60a p. 106, 1907.

Banks in *Journ. Fed. Malay Mus.*, 16, p. 392, 1931, writes 'In the series of *G. ursina* Hagen there are no males.'



Figs. 157–161. *Goerodes 'khasiana* sp.n. ♂ 157, wings. 158, maxillary and labial palpi, lateral. 159, genitalia, lateral. 160, genitalia, dorsal. 161, ninth segment and inferior appendages, ventral.

In the collection of the British Museum, the species is represented by a single female, a co-type. This specimen is reddish brown in colour and I give here a figure of the neuration.

Having regard to the similarity in the neuration of nearly all females in this genus, it is improbable that it is correctly associated with its male.

Co-types ♀ in the collections of the British Museum and of the Museum of Comparative Zoology, Harvard College, Mass., U.S.A.

The following species is unknown to me. It is doubtful whether it can be recognized from its descriptions but it clearly belongs to the Lepidostomatinae.

Goerodes mustellina (Hagen)

Mormonia ursina Hagen, Synops. 1, Nr. 79, var? *minor*

Mormonia mustellina Hagen, Verh. Zool. Bot. Ges. Wien, 9, p. 209, 1859.

Goerodes mustellina Ulm., Gen. Insect., fasc. 6, p. 106, 1907.

'Fusca; antennis flavidis, articulo basali, longo recto, subtus flavo barbato; palpis maxillaribus clavatis recurvis, flavo pilosis; capite thoraceque fuscis, flavo pilosis; pedibus luteis, anticis fuscis; alis fuscis, fusco hirtis (Mas).

Long. c. alis 6½ mill. Exp. al. 11 mill. Hab. Rambodde, Nietner.'

Goerodes khasiana sp. n. Figs. 157-161.

Insect yellowish. In the ♂, anterior wings bearing dense hairs amongst which are elongate, white scales; costa folded over from nearly the base to a point opposite the distal end of the discoidal cell; post-costal fold short, terminating in a narrow cell; posterior wing of the type aberrant, with a small cell below the discoidal cell enclosing the corneous point; in other respects the neuration as usual. Antenna with the basal joint somewhat shorter than the width of the head with the oculi. Maxillary palpi single-jointed, broad.

Genitalia ♂:—Apical margin of the ninth tergite produced in two pairs of processes, the inner short and membranous, one process longer than the other, the outer long, sinuous, strongly chitinized and asymmetric; penis short and stout, elbowed abruptly downward; inferior appendages branched, the main branch with the inner margin irregular, excised as shown in the figure of the ventral aspect; from the side, stout at the base, terminating in a slender branch; a branch arising from near the upper margin towards the base, with a slender stem and greatly dilated apex which appears as a narrow wart from above; from beneath may be seen a short ventral branch to the appendage arising rather from the middle of its upper surface than the usual situation on the upper, inner margin.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna 0.72 mm.

Assam:—Khasi Hills, from the MacLachlan collection.

Type and paratypes ♂ in the collection of the British Museum.

Goerodes palnia sp. n. Figs. 162-165.

Insect pale fuscous. In the ♂, basal joint of the antenna as long as width of head with the oculi; a triangular wart arises between the bases; maxillary palpi single-jointed, bearing a tuft of broad scales; wings covered with pale hairs intermingled with scales; anterior, costal margin rounded and narrowly turned over onto the sub-costa for nearly its entire length; post-costal fold long; in the posterior wing, the fourth apical cellule extends slightly further inwards than the basal angle of the discoidal cell.

Genitalia ♂:—Ninth tergite produced in the centre of its apical margin in two pairs of processes, the outer forming strongly chitinized, sinuous, stout spines, somewhat asymmetric, seen from the side with wide bases, lower margins of which are convex, the inner, which are much smaller, are membranous, finger-shaped and fringed with widely spaced, long hairs; the ninth segment is produced above these processes in a small, triangular prominence; penis short and curved, apex curled over in a flattened tongue; inferior appendages branched but not two-jointed, the basal part is wide for about two-thirds of its length, then it is cut across to leave a shelf with the inner angle forming a triangular projection and the outer produced in a broad branch with a rounded apex; from the side, a second branch is seen to arise from the upper margin near the base; this branch is slender and rod-like; ninth sternite produced at the centre of its margin.

Length of the anterior wing ♂ 8 mm.

Palnis: Kodaikanal, 2. ix. 1921, Fletcher collection.

Type ♂ in the collection of the British Museum.

Goerodes piscina (Hagen).

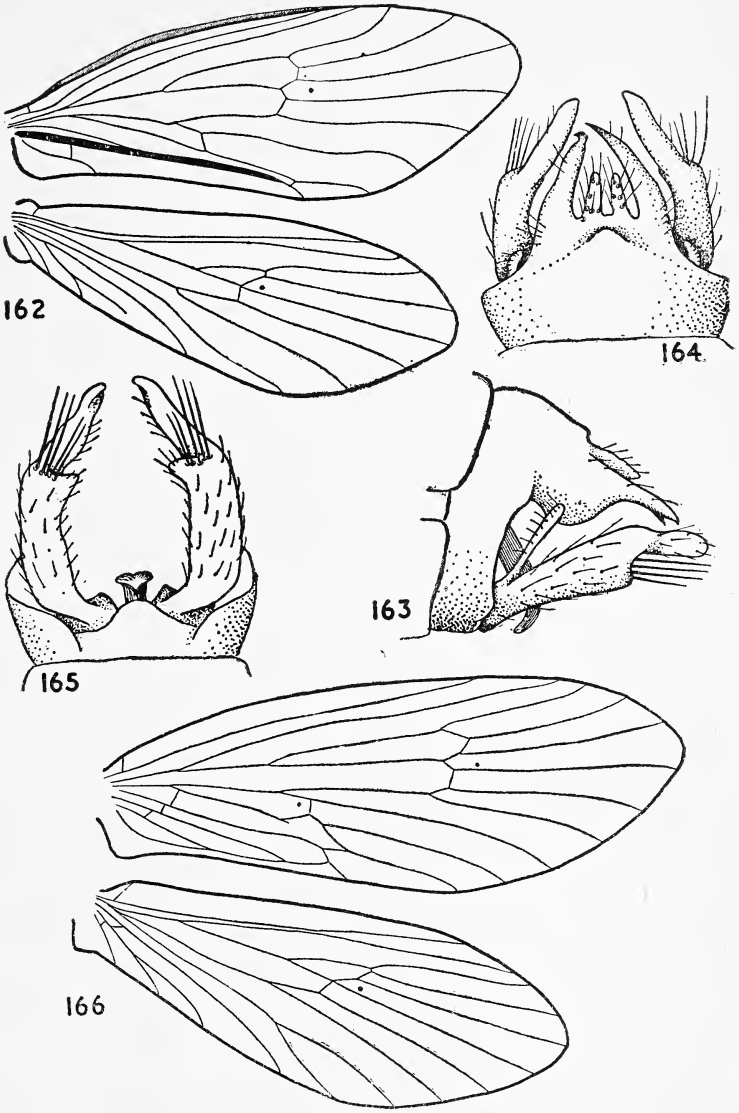
Mormonia piscina Hagen, Verh. zool.—bot. Ges. Wien, 9, pp. 208-9, 1859.

Goerodes piscina Ulmer, Gen. Insect., fasc. 60a, p. 106, 1907.

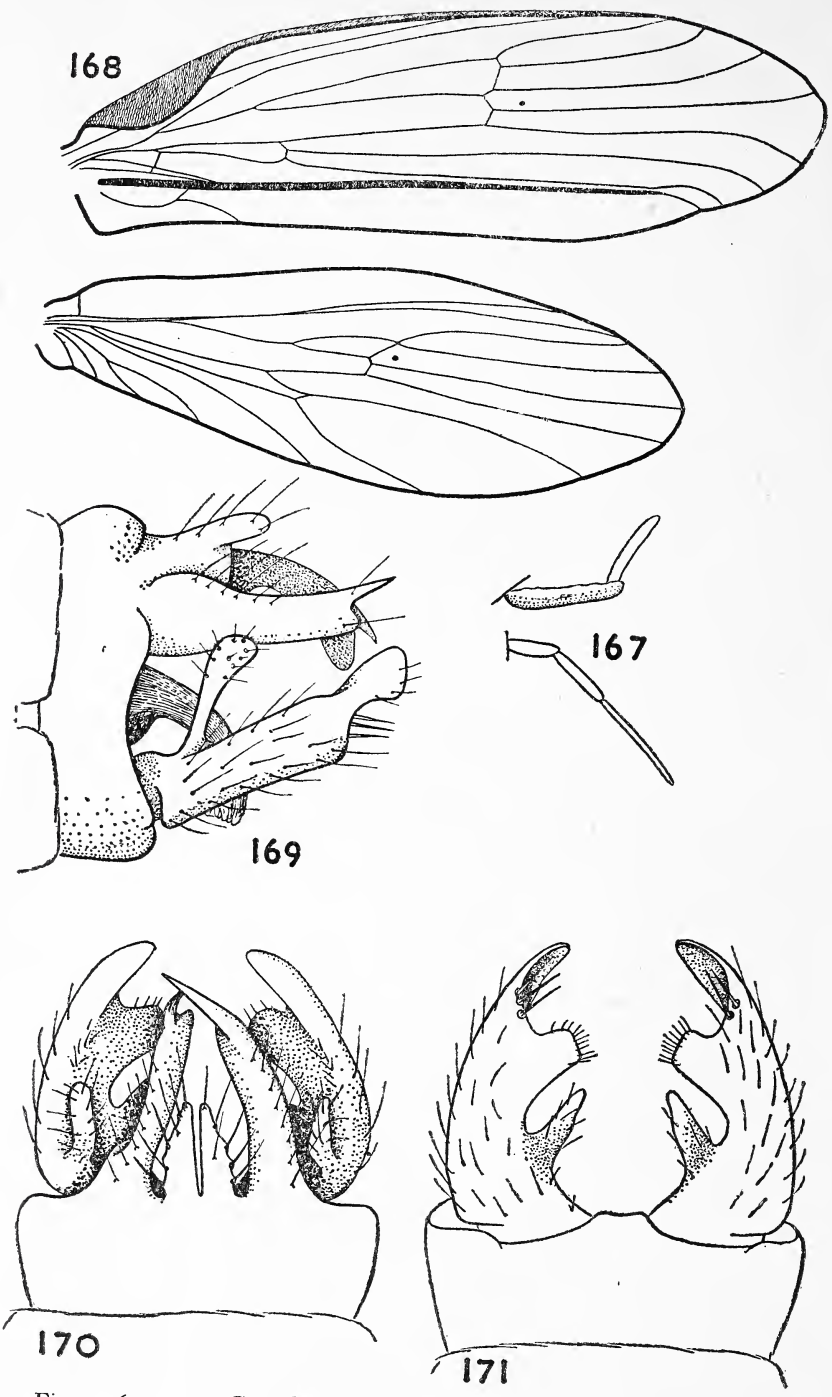
Goerinella piscina Ulmer, Deuts. ent Zeit., 1915, pp. 68-70, 75, figs. 44-7, 1915.

Insect brownish. Description of the ♂: basal joint of the antenna rather longer than the width of head with oculi; maxillary palpi two-jointed, basal joint longer and more strongly chitinized on the under than on the upper side; the terminal joint membranous, clothed with a mat of broad hairs and arising from before the apex of the first joint; labial palpi three-jointed, the second joint longer than the first and shorter than the third; wings, anterior, clothed with hairs and scales, costa doubled over the sub-costa rather deeply at the base, the fold narrowing towards the apex of the wing; post-costal fold very long; posterior wing, sub-costa much thickened and confluent with the radius at about midway, separated at the apex; a cross-vein between the cubitus and the medius forming a doubtful fork no. 5.

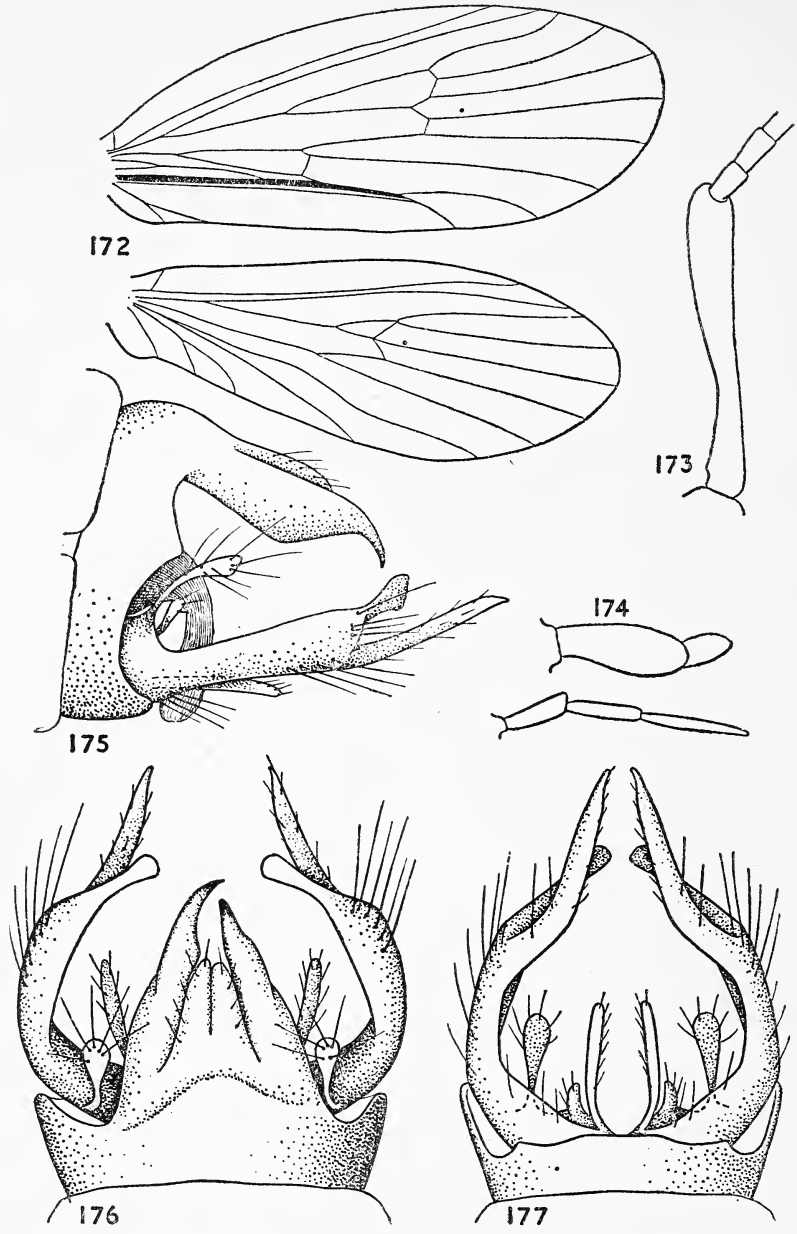
Genitalia ♂:—Dorsal margin of the ninth segment produced in the centre in two pairs of processes, the inner close together, small, finger-like, with strongly serrate outer margins, the outer



Figs. 162–166. *Goerodes palnia* sp.n. ♂ 162, wings. 163, genitalia, lateral. 164, genitalia, dorsal. 165, ninth segment, inferior appendages and penis, ventral. 166, *Goerodes ursina* (Hagen) ♀. Wings of co-type.



Figs. 167–171. *Goerodes piscina* (Hagen) ♂. 167, maxillary and labial palpi, lateral. 168, wings. 169, genitalia, lateral. 170, genitalia, dorsal. 171, ninth segment and inferior appendages, ventral.



Figs. 172–177. *Goerodes punda* sp.n. ♂. 172, wings. 173, base of antenna. 174, maxillary palpus from in front, lanial palpus from side. 175, genitalia, lateral. 176, genitalia, dorsal. 177, ninth segment and inferior appendages, ventral.

long and stout, arising from very stout bases, as seen from the side, asymmetric, the apex of each process bifurcate, the upper fork acute, the lower blunt and rounded in the one, in the other, there is a truncate apex, the upper angle produced in a pointed finger; penis short, arching downward; inferior appendages single-jointed, and branched; from beneath, there are two branches arising on the inner margin, the lower straight and pointed, the upper wide and rounded, both directed inwardly and distally; above the second branch, the appendage is cut away on its inner margin leaving a narrow apex simulating a second joint at the base of which are two or three stout spines; from the side may be seen an additional branch arising from the upper margin towards the base, with a slender stem and much dilated apex curving somewhat distally.

Length of anterior wing ♂ 10 mm.

Length of the anterior wing ♀ 8 mm.

Ceylon.

Goerodes punda sp. n. Figs. 172-177.

Insect yellowish. In the ♂ anterior wings bearing a dense mass of small scales intermingled with hairs; costal margin rounded; discoidal cell about as long as its footstalk; all the apical cellules sessile; post-costal fold extending to a point nearly opposite the distal end of the discoidal cell; posterior wing with the neuration regular. Basal joint of the antenna slightly longer than the width of head with the oculi. Maxillary palpi two-jointed, basal joint from beneath, very broad, nearly double the length of the terminal joint; both joints covered on the upper surfaces with broadened hairs.

Genitalia ♂:—Dorsal plate produced in two pairs of long processes, the outer broad at the bases, terminating in acute, strongly chitinised, sinuous spines, the inner shorter, set close together and parallel; penis short and curved; inferior appendages five-branched; a branch with a very slender stem and a dilated apex arising from the upper margin near the base, directed upward; a second slender branch at the extreme base of the ventral margin; the third branch is very small, transparent and concealed; it arises towards the base of the appendage between the first and second branches; the apex of the appendage is forked, the upper fork shorter than the lower and terminating in a clavate apex, the lower produced and acute.

Length of the anterior wing ♂ 7 mm.

Ceylon: Pundaluoya, Sept. 1897. ex MacLachlan coll.

Type ♂ in the collection of the British Museum.

Goerodina gen. n.

Spurs, 2, 4, 4. In the ♂, the basal joint of the antenna armed with two processes, both situated at the extreme base, one furcate, the other simple and very small. Maxillary palpi two-jointed, basal joint stout, long, slightly curved, with a small membranous

branch at its apex, terminal joint short. Wings clothed with hairs and scales; anterior with the post-costal fold short, situated near the lower margin of the wing. Inferior appendage branched at the apex and with an upright branch at the base, rather irregular in shape.

Genotype:—*G. serrata* sp n.

Goerodina dubitans sp. n. Figs. 178-184.

Insect brown. In the ♂, wings covered with hairs and scales, the latter very dense; in the anterior, the costa is not folded; post-costal fold short, terminating in a large cell; the fifth and sixth apical cellules are based upon a round, false cellule bare of hairs or scales and situated about midway between the base of the discoidal cell and the distal end of the post-costal fold; discoidal cell rather short. Basal joint of the antenna about one and a half times as long as the width of the head with the oculi, armed with two processes of which the basal is complicatedly furcate, the distal, short and simple; above these processes the joint is excavated, the excavation lined with a series of bars. Maxillary palpi membranous and two-jointed, the basal joint large with a rounded knob towards the apex, terminal joint short and thick.

Genitalia ♂:—The apical margin of the ninth tergite is produced in a large, triangular plate, apex slightly excised; penis short and downcurved; no apparent sheaths; inferior appendages with a slender branch arising from the centre of its upper surface at the base, directed upward, apex not dilated as is usual; apex of the appendage probably three-branched, outer branch rounded, lower finger shaped, apex slightly dilated, the third with a wide excision of its dilated apex; from the side, there is a rounded production of the base of the lower margin.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna 1.58 mm.

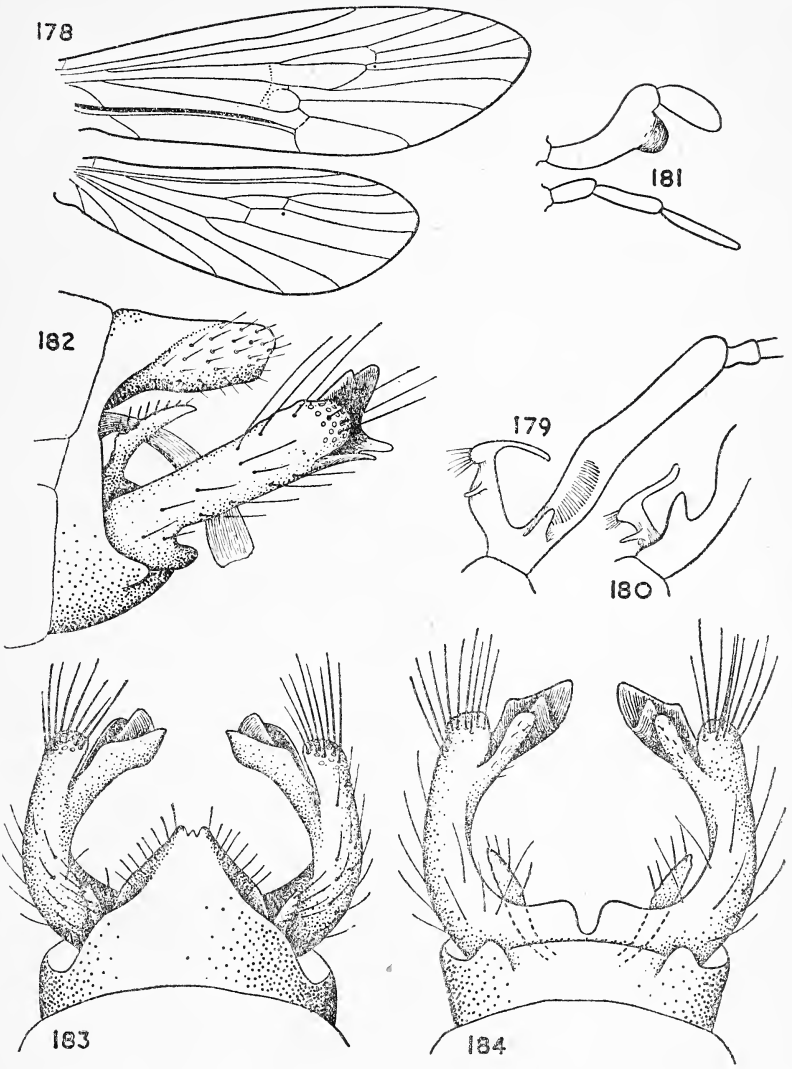
Assam: Khasi Hills, from the MacLachlan collection.

Type ♂ in the collection of the British Museum.

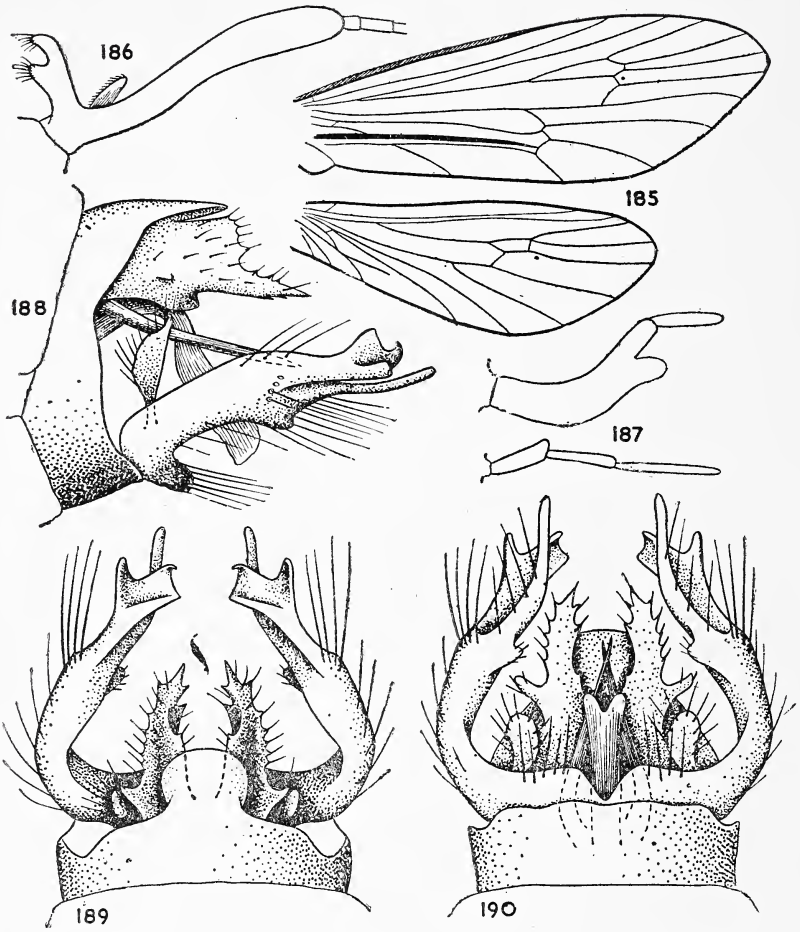
Goerodina serrata sp. n. Figs. 185-190.

Insect brownish. In the ♂, anterior wings covered with hairs and scales; costa narrowly folded over from the base to a point opposite the base of the discoidal cell which is narrow; post-costal fold about half the length of the wing; three large cells in the post-costal area; in the posterior wing, apical cell no. 3 unusually broad. Antenna with the basal joint considerably longer than the width of the head with the oculi and furnished with a pair of processes at its base, the longer bifurcate towards the apex, where it is considerably dilated. Maxillary palpi membranous, covered with broad hairs, two-jointed, basal joint stout, long, slightly curved with a membranous branch towards its apex; second joint short and slender.

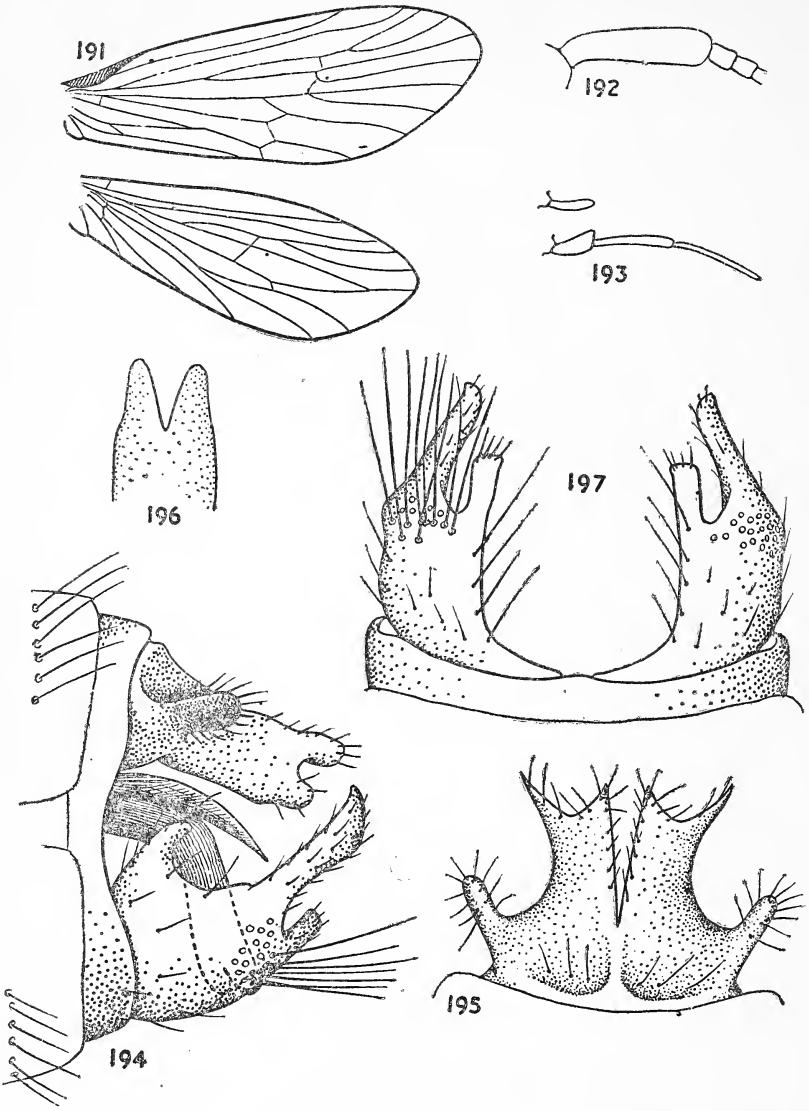
Genitalia ♂:—Apical margin of the ninth tergite produced in a large, rounded plate, beneath which is a pair of processes with



Figs. 178–184. *Goerodina dubitans* sp.n. ♂. 178, wings. 179, base of antenna, inner surface. 180, the same, from beneath. 181, maxillary and labial palpi, lateral. 182, genitalia, lateral. 183, genitalia, dorsal. 184, ninth segment and inferior appendages, ventral.



Figs. 185–190. *Goerodina serrata* sp.n. ♂, 185, wings. 186, base of antenna. 187, maxillary and labial palpi, lateral. 188, genitalia, lateral. 189, genitalia, dorsal, penis and sheaths omitted. 190, genitalia, ventral.



Figs. 191–197. *Paraphlegopteryx brunneus* sp.n. ♂. 191, wings. 192, base of antenna. 193, maxillary and labial palpi, lateral. 194, genitalia, lateral. 195, dorsal plate from above. 196, upper penis cover, (?), dorsal. 197, ninth segment and inferior appendages, ventral.

strongly serrated margins, with small, projecting branches on their outer margins near the base; from the side, the serrate process is broad at the base with a nearly right-angled excision of the upper margin leaving a narrow distal finger very acute at its apex; penis elbowed downward, apex deeply excised; sheaths very long, apices crossing; inferior appendages branched, main stem with an irregularly shaped apex as seen in the figure, a long, sinuous branch arising beneath it from rather nearer the apex than midway, this branch with a slight projection of its inner margin near the base; a basal branch arises from the upper surface of the appendage towards its base; this has the usual slender or constricted stem with a dilated apex but the apex is more elongated than is usual, seen from the side; there is a strong projection of the lower margin of the appendage at the base.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna 1.4 mm.

Assam: Khasi Hills, from the MacLachlan collection.

Type ♂ in the collection of the British Museum.

Paraphlegopteryx Ulmer.

Paraphlegopteryx Ulm., Notes Leyd. Mus., 29, pp. 5-6, 1907.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna about as long as the width of the head with the oculi, without processes. Maxillary palpi single-jointed, short and cylindrical. Wings clothed sometimes with hairs and scales, sometimes with hairs alone; no post-costal fold in the anterior; neuration in the posterior irregular, sometimes with a groove containing dense black spinules. Inferior appendages stout, sometimes furcate. No well-defined erect branch at the base.

In all the species, in the ♂, there is a large, shieldshaped, black spot on the metanotum.

Genotype: *P. tonkinensis* Ulmer.

Paraphlegopteryx brunneus sp. n. Figs. 191-197.

Insect brown; wings broad; anterior clothed with hairs only, the base of the costa turned over and bearing a dense fringe; no post-costal fold; discoidal cell long and narrow; fork No. 1 with a footstalk; posterior wing clothed with hair and scales, the latter collected in a band following the apical and posterior margin of the wing; subcosta thickened, fork No. I long and narrow with a short footstalk, discoidal cell long and narrow, media flowing into the lower branch of the radial sector; basal joint of the antenna rather shorter than the width of the head with the oculi; maxillary palpi with a single, short, cylindrical joint curving slightly upward and heavily fringed on its lower surface; spurs of the anterior tibiae long and distinct.

Genitalia ♂:— The tergites bear groups of long hairs; apical margin of the ninth straight; beyond it is a dorsal plate, deeply excised at its centre to leave a pair of processes with concave apical margins separated from the produced lateral angles of the

plate by rounded excisions and about twice their length; penis arching downwards, a divided plate (upper penis cover?) covering the apex; sheaths short and broad, lying over its base and concealed under the dorsal plate; inferior appendages single-jointed and three-branched, broad at the base; a short branch on the upper margin near the base, directed upwards; the appendage is then narrowed in a pair of branches of which the outer and upper is long, the inner short; from beneath, the appendages are widely separated and the apices of the inner branches are truncate.

Length of the anterior wing ♂ 10 mm.

Length of the basal joint of the antenna 0.89 mm.

N. E. Burma: Kambaiti, 6800 feet, 7. iv. 1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Paraphlegopteryx compositus Mart. Figs. 198-204.

Paraphlegopteryx compositus Martynov, 1936, Rec. Ind. Mus., 38, p. 291.

Head dark ochraceous; oculi black; basal joint of antenna rather shorter than the head together with the oculi; maxillary palpi short and cylindrical, apparently single-jointed, sparsely clothed with long hairs; labial palpi, second joint longer than the first and shorter than the third; pronotum and mesonotum dark ochraceous, legs ochraceous. For further particulars, see generic description.

Genitalia ♂ :— Margin of the ninth dorsal segment evenly rounded; beyond it is a large dorsal plate with two triangular projections at the base and the apex produced in two large triangles with a narrow excision between; beneath this is a pair of flat, blade-like penis-sheaths covering a short, downwardly arching penis; inferior appendages three-branched, with a broad base which is produced to make a first branch; at the base of this branch, on the under surface is a rounded wart covered with short setae and seen from beneath, a second wart or minute process on the inner margin opposite it; the second branch arises at about midway, seen from the side, it is short and lies parallel with the first branch; the third branch is slender and arises towards the upper margin of the base of the appendage, curving upwards and tailwards.

Length of the anterior wing ♂ 9 mm.

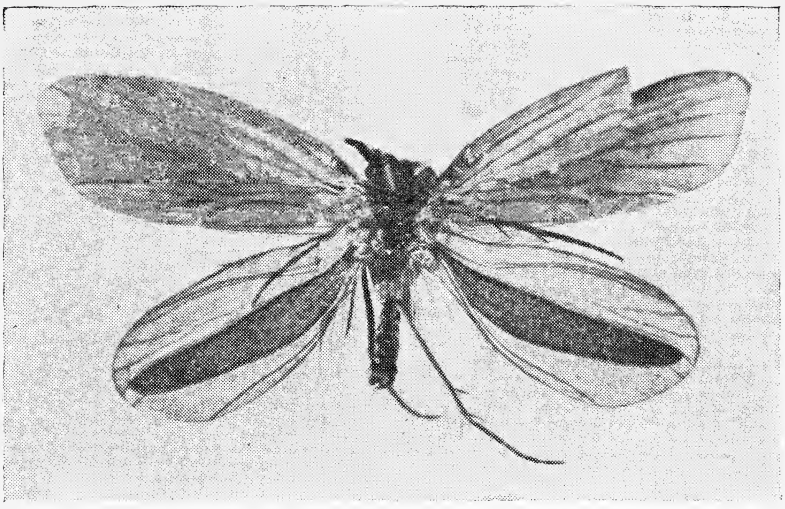
Kumaon: Muktesar, 7,500 feet, 14. ix. 1922, Fletcher coll.

The locality of the type is E. Himalayas, Darjeeling district.

Paraphlegopteryx normalis sp. n. Figs. 206-209.

Head dark fuscous, nearly black; oculi black; antennae dark ochraceous, basal joint about as long as the breadth of the head including the oculi; palpi and legs dark ochraceous; wings fuscous, anterior with area between the costa and subcosta thickly beset with thickened hairs and scales in both wings; scales or thickened hairs sparingly seated on the nervures and more thickly along the posterior border of the posterior wing.

Genitalia ♂ : The eight tergite modified and produced in a large, rounded dome overshadowing the genitalia from above; the



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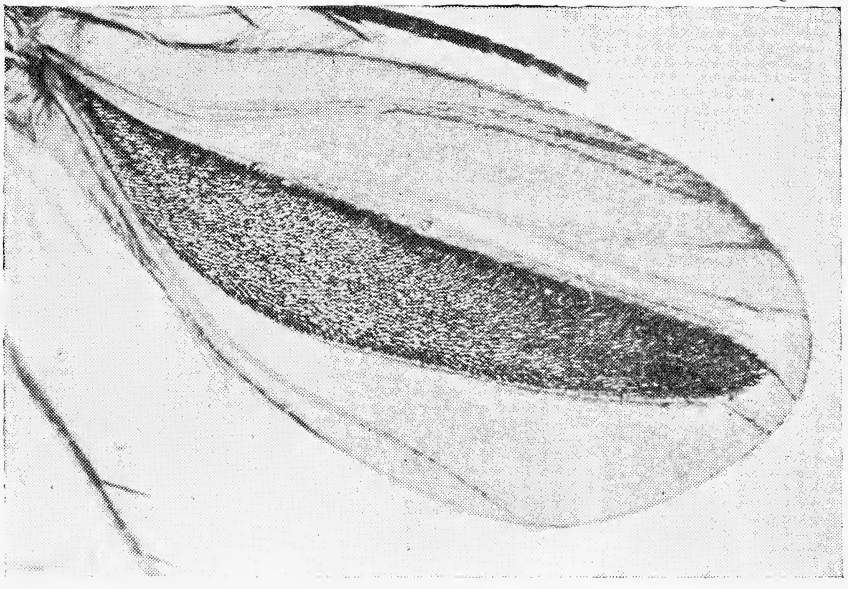

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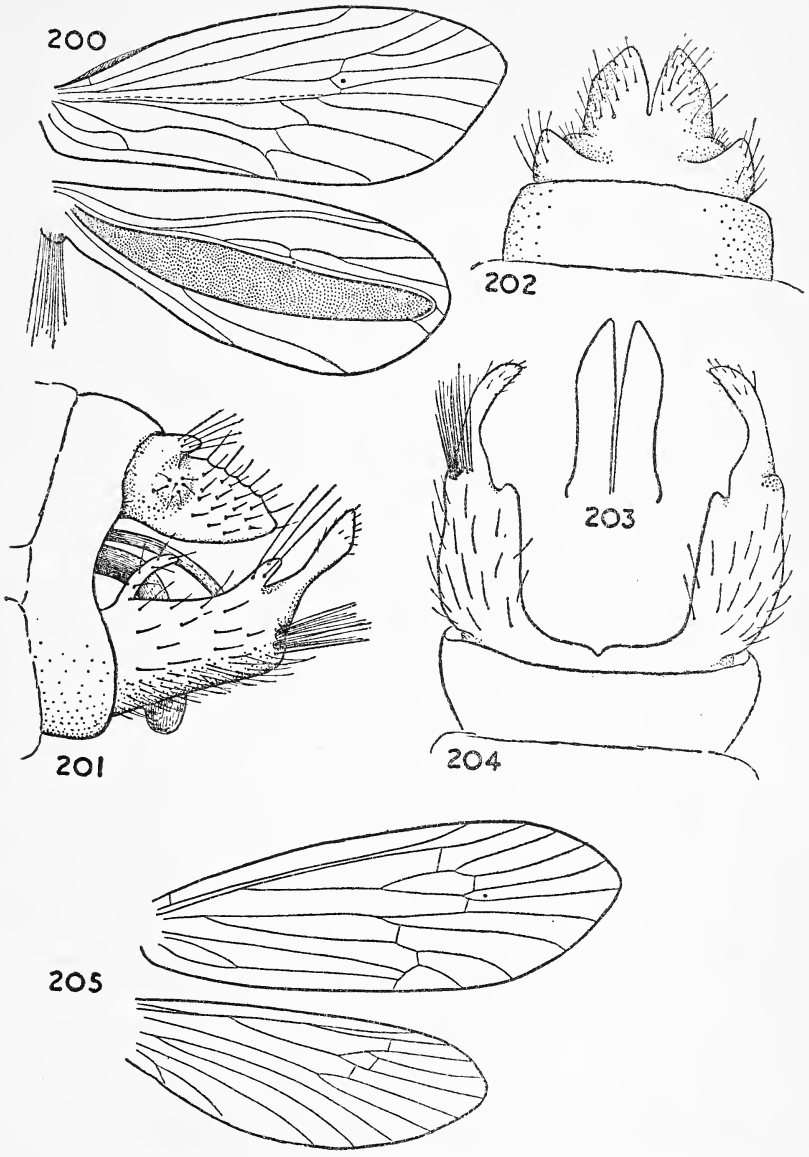
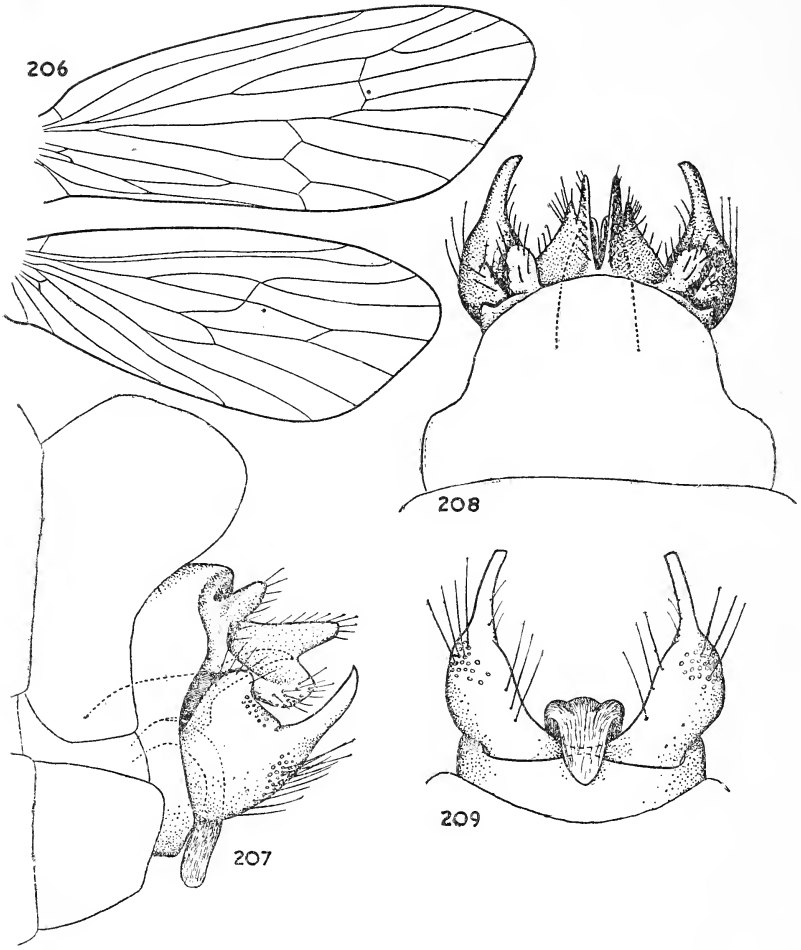
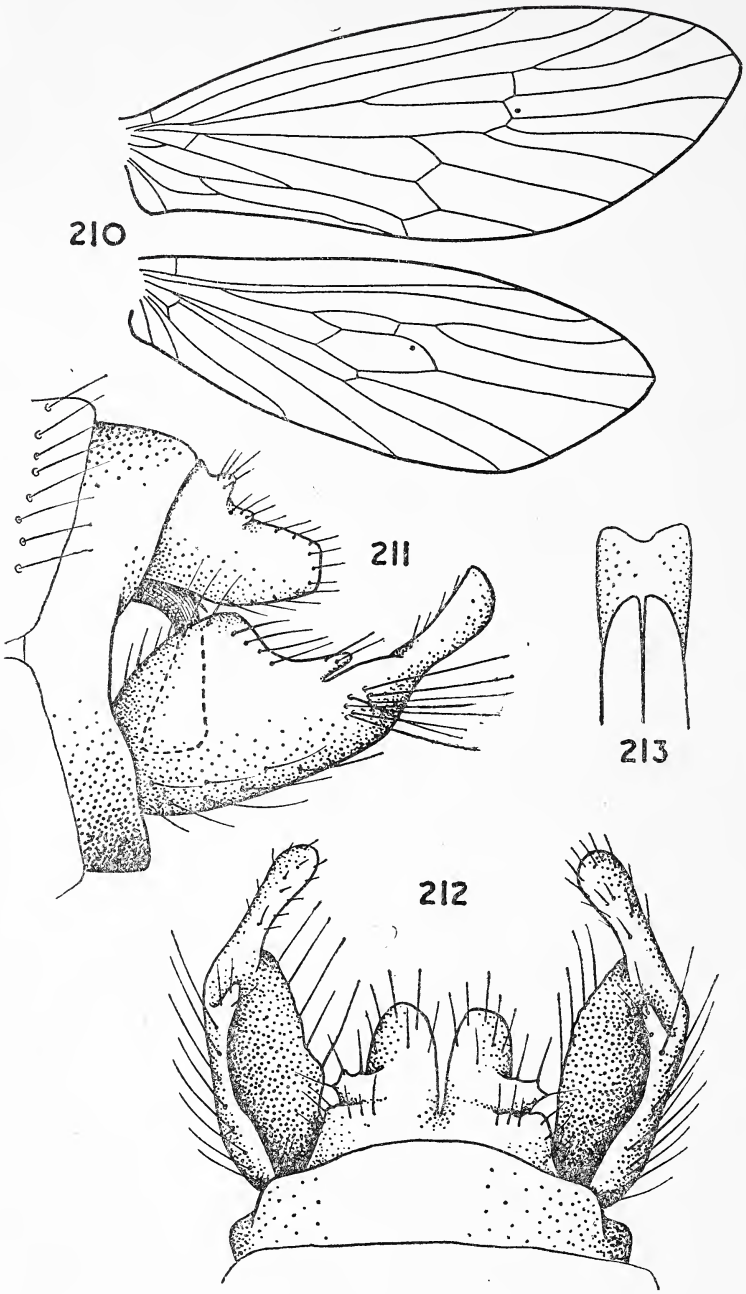
Figs. 198–199. *Paraphlegopteryx compositus* Mart. ♂. Example from Kumaon, and enlargement of posterior wing.



Figs. 200–205. *Paraphlegopteryx compositus* Mart. ♂. 200, wings. 201, genitalia, lateral. 202, ninth segment and dorsal plate, dorsal. 203, penis sheaths, dorsal. 204, inferior appendages, ventral. 205, *Ignasala fuscata* Navás. ♂. Wings (after Navás).



Figs. 206–209. *Paraphlegopteryx normalis* sp.n. ♂. 206, wings. 207, genitalia, lateral. 208, genitalia, dorsal. 209, ninth segment, inferior appendages and penis, ventral.



Figs. 210–213. *Paraphlegopteryx rufus* sp.n. ♂. 210, wings. 211, genitalia, lateral. 212, genitalia, dorsal. 213, penis and sheaths, dorsal.

ninth tergite is reduced beneath the dome and carries a dorsal plate with a pair of widely separated, narrow processes towards its basal margin, whilst its apical margin is produced at its centre in a pair of deep plates whose lateral margins are bent downwards and inwards to form deep hood; upper penis-cover lying close up under the hood; penis short and strongly arched; inferior appendages with broad, rounded bases, the narrow apices produced and pointed; from the side, the apical margin of the basal part is somewhat truncate, the produced apex arising from the lower apical angle.

Length of the anterior wing ♂ 8 mm.

Darjeeling.

Type ♂ in the collection of the Munich Museum.

Paraphlegopteryx rufus sp. n.

Insect reddish-brown; wings broad and rounded, clothed with hairs but without scales; anterior, discoidal cell long and narrow; posterior, neuration irregular; fork No. I in both wings with a footstalk; no folds or grooves in either wing; basal joint of the antenna of about the same length as the width of the head with the oculi; maxillary palpi single-jointed, short and cylindrical.

Genitalia ♂:— The apical margin of the ninth tergite slightly rounded; beyond it is the dorsal plate, from above produced in a pair of stout processes with rounded apices, separated from each other by a deep excision; towards the base of each process, on its outer margin, is an irregularly shaped projection; from the side, the plate is roughly rectangular; the whole plate with its processes sparsely clothed with long hairs; penis very short and curved; sheaths forming a pair of short, flat plates above its base; inferior appendages broad at the base which is ear-shaped from above, apical portion produced and directed inwards, apex clavate; lying along the upper margin as seen from the side, is a short branch directed distally.

Length of the anterior wing ♂ 10 mm.

N. E. Burma: Kambaiti, 12. vii. 1934, 6,300 feet, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Ignasala Navás

Ignasala Navás, Revist. Ac. Cienc. Zaragoa, 15, p. 39, 1932.

Navás describes the genus as follows:—

Etim. En obsequio del P. Ignacio Sala, S. J., a quien tanto debe la entomología de Bombay.

Similis generi *Atomyia* Banks.

Caput antennis articulo primo longo, fere aequali latitudini capitis cum oculis.

Abdomen cercis inferioribus ♂ grandibus.

Alae elongate, parum dilatatae, maxima dilatatione in tertio apicali; venis axillaribus 1 et 2 modo solito dispositis; cellula discali clausa, alae posterioris parva, anterioris multo longiore; furcis apicalibus

ut in *Atomyia*, hoc est: in ♂: ala ant. 1, 2, 5, post. 1; in ♀ ala ant. 1, 2, 3, 5, al. post. 1, 2, 5.

Cetera ut in *Atomyia* Banks.

Se distingue de *Atomyia* por la mayor longitud del primer artejo de las antenas, asi como de la celdilla discal del ala anterior y en la misma por la posición normal de las venas axilares 1 y 2, si hien presentan alguna anomalía en su terminación.

El tipo es la siguiente especie.

Ignasala fuscata Navás Fig. 205.

Ignasala fuscata Navás Revist. Ac. Cienc. Zaragoza, 15, pp. 40-41 fig. 38, 1932.

Navás describes the species as follows:—

Caput fusum, nigro pilosum; oculis fuscis; palpis maxillaribus brevibus, fuscis, duobus articulis ultimis fulvis fulvoque pilosis; antennis articulo primi longo, longiore latitudine capitis, apicem versus leviter incrassato, fusco, piloso, apice fulvo, ceteris fulvis, fusco annulatis, in ♀ pallidioribus.

Thorax inferne fulvus, superne piceus, fusco pilosus.

Abdomen fuscum, inferne pallidius, appendicibus testaceis; cercis inferioribus ♂ grandibus, leviter ascendentibus, sensim angustatis, medio convergentibus, pilis fulvis, in medio apicali plerisque fuscis.

Alae angustae, membrana fusco tincta; reticulatione, pilis fimbriisque fortibus fuscis.

Ala anterior furcis apicalibus 2, 1, 5 longitudine decrescentibus, sessilibus; cellula discali angusta, plus quadruplo longiore latitudine.

Ala posterior cellula discali brevi, extrorsum dilatata, duplo longiore sua latitudine; furcis apicalibus 1, 2, longis sessilibus, 5 brevi, longiter pedunculata.(refers to ♀ wing)

Long. corp. ♂ 3.7 mm.; ♀ 3.6 mm.

Long. al. ant. ♂ 6.6 mm.; ♀ 6.5 mm.

Long. al. post. ♂ 5.5 mm.; ♀ 5.3 mm.

Patria: Khandala (Bombay) 12-24.v. 1927, 22-28. x. 1928.

Leg. P. Sala, S. J.

Navás gives figures and dimensions of the wings in both sexes. Having regard to the numerous species in the sub-family I am of opinion that the association of the ♂ with the ♀ is uncertain. I therefore reproduce here the figure of the ♂ wings only. Navás gives no figures of the all-important genitalia.

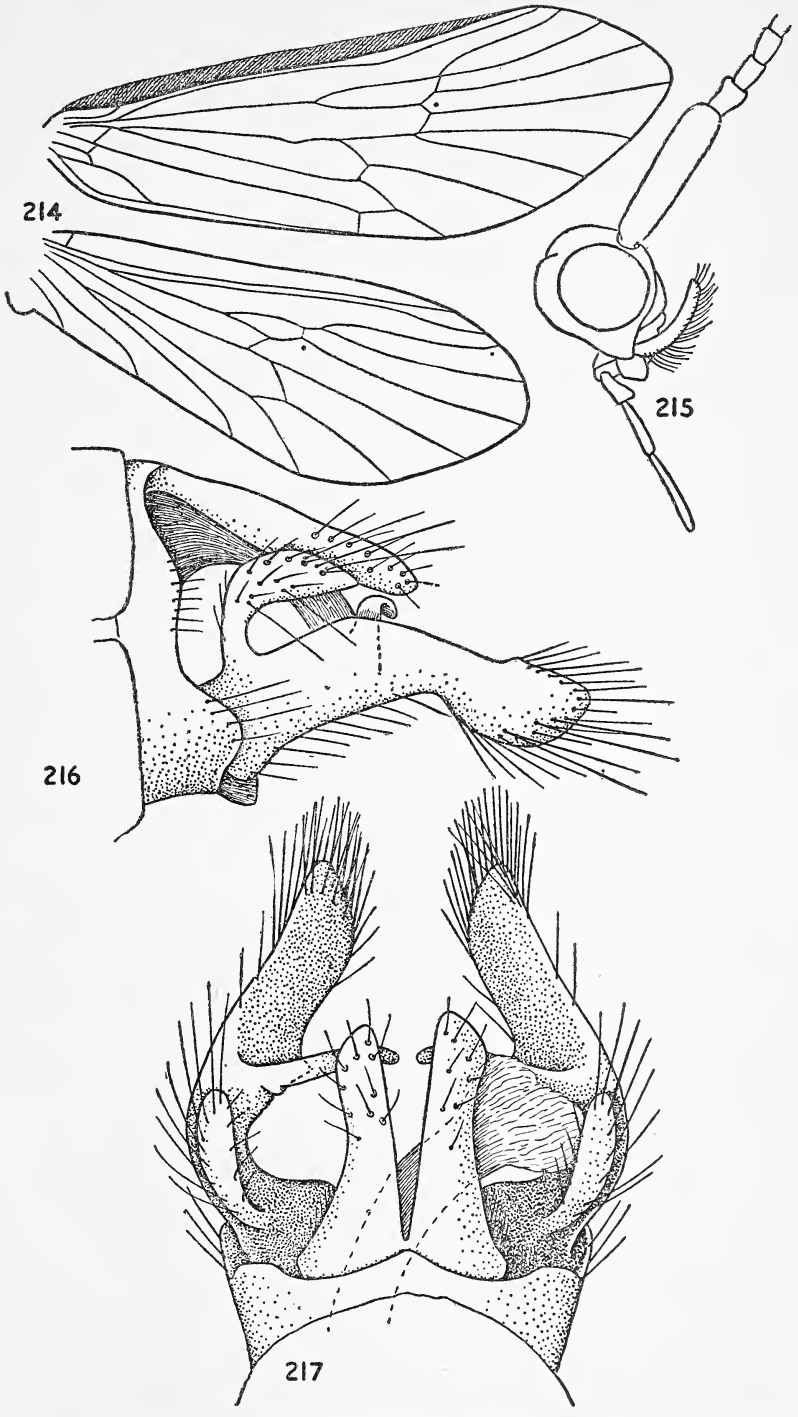
Kodala gen. n.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna short, without processes. Maxillary palpi single-jointed. Wings clothed apparently with hairs only; costa folded over the wing for nearly its entire length; no post-costal fold. Inferior appendages single-jointed and branched.

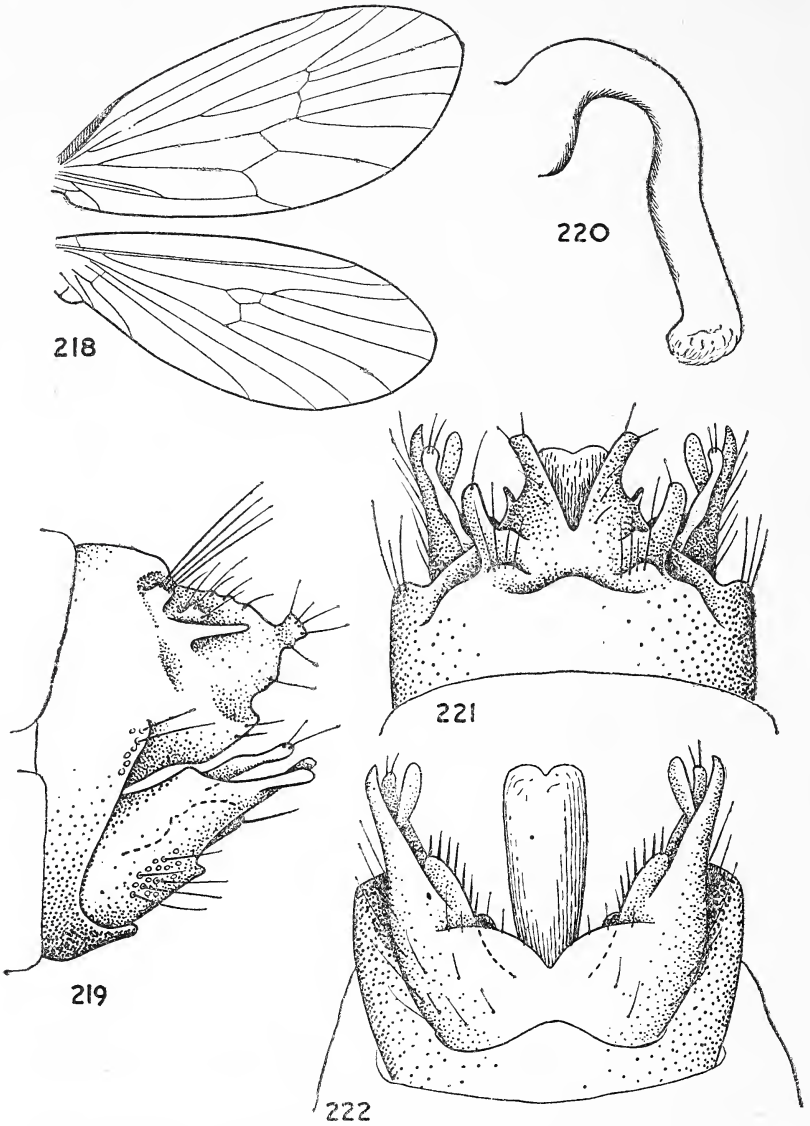
Genotype: *K. lanca* sp. n.

Kodala lanca sp. n. Figs. 214-217.

Insect small and brownish; anterior wing with the costal border turned over, no fold in the post-costal area, wing almost entirely



Figs. 214–217. *Kodala lanca* sp.n. ♂. 214, wings. 215, head, lateral. 216, genitalia, lateral. 217, genitalia, dorsal.



Figs. 218–222. *Indocrunoecia heterolepidia* Mart. ♂. 218, wings (after Martynov). 219, genitalia, lateral. 220, penis, lateral. 221, genitalia, dorsal. 222, ninth segment, inferior appendages and penis, ventral.

denuded in the type and the vestiture consisting of hairs, no visible scales; antennae with the basal joint rather longer than the depth of the head from the side; maxillary palpi single-jointed; labial palpi three-jointed, basal joint the shortest.

Genitalia ♂ :—Dorsal plate larger and bifid; penis asymmetrically directed to one side, apex dilated and membranous; inferior appendages single-jointed and branched, apex fringed with very long, stiff hairs; basal branch, from the side, elbowed and directed distally; middle branch bent inwards at right angles, arising from the centre of the inner surface.

Length of the anterior wing ♂ 6 mm.

Palnis: 7,000 feet, Kodaikanal, 15 Sept. 1921, Fletcher Coll.

Type ♂ in the collection of the British Museum.

Indocrunoecia Martynov.

Indocrunoecia Mart., Rec. Ind. Mus., 38, p. 293, 1936.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna short, without processes. Maxillary palpi two-jointed, basal joint long, terminal rather short. Wings clothed with hairs and scales, costa folded over the wing near the base; no post-costal fold. Inferior appendages branched, no erect branch at the base.

Genotype: *I. heterolepidia* Mart.

Indocrunoecia heterolepidia Martynov Figs. 218-222.

Indocrunoecia heterolepidia Mart., Rec. Ind. Mus., 38, pp. 293-295, figs. 66-67, 1936.

Insect light brown. In the ♂, basal joint of the antenna as long as the breadth of the head with the oculi, no processes at its base. Maxillary palpi two-jointed, basal joint long, second joint very small, if present at all. Anterior wing broad, egg-shaped, greyish yellow, clothed with hairs and elongate, whitish scales; discoidal cell long and narrow; no post-costal fold; in the posterior wing, fork No. I with a very short footstalk, otherwise neuration regular.

Genitalia ♂ :—The apical margin of the ninth tergite produced in a large dorsal plate deeply excised at the centre of its margin to leave two triangular processes with produced apices; lateral angles of the plate produced in slightly incurving, finger-like processes; from the side, the dorsal plate is very broad with an irregular lower apical margin; lateral angular projections slender, straight and directed distally; penis short and straight; inferior appendages three-branched at the apices, all the branches short, nearly equal in length with more or less slender stems and dilated apices; from beneath, there is a shelf-like plate projecting from about the centre of the inner surface; bases of the appendages fused together to form a pair of broad plates.

Length of the anterior wing ♂ 7 mm.

East Himalayas, Darjeeling District.

Type and paratypes in the collection of the Indian Museum, Calcutta.

(The end)

ON A COLLECTION OF FISH FROM TRAVANCORE

BY

E. G. SILAS, B.SC.

(With a sketch map in text)

Communicated by Dr. S. L. Hora, D.Sc., F.N.I., etc.

INTRODUCTION

The fresh-water fish fauna of Travancore has received considerable attention in recent years. After Day's 'Fishes of Malabar' (1865)* and 'Fishes of India' (1876-1888), Pillay (1929), John (1936), Hora and Law (1941), Hora and Nair (1941), Raj (1941 *a*) and Chacko (1948) have reported on the fishes of Travancore.

The present collection was made from two areas in April 1949; one from the hill-streams of Balamoore and Thadikarakonam in Southern Travancore and the other from the canals in Alleppey, Northern Travancore.

The fish fauna of Southern Travancore is perhaps of special interest when the system of waterways is taken into account. All the rivers and lakes south of Calicut from Ponnani in Malabar to Trivandrum in Travancore are connected by canals and backwaters to form a continuous 'System'. But the rivers and streams south of the river Neyyar in Southern Travancore form a separate 'System' and are not connected with those of the north. So far no exhaustive collection seems to have been made from this Southern section. In view of the discontinuity between the water-ways of the southern from the northern sections of the State and the continuity and similarity in the topography of the land in the southern section to that of the Tinnevelly District, there is a likelihood of a considerable affinity between their respective fish faunas. Observations on the fish fauna of the streams in the plains have already shown the presence of a number of sluggish forms similar to those of the Madras Province. The Western ghats at this region are of lesser elevation than those of the north and a few miles south they end in the form of low hills. The rainfall is much less and the terrain is more rocky and consequently the forests are less dense. The hill-streams also flow abruptly into the plains and are torrential in nature.

The Kalikayam and Thadikarakonam streams are perennial and are characterized by a series of rapids, falls and pools along their respective courses. Collections from the above streams contain a number of forms previously recorded only from northern and central Travancore. At the time of making the collections, in addition to the fishes, the writer noted the presence of a number of insect larvae also, such as those of Trichoptera (caddis flies), Ephemeroptera (may-flies), Chironomidae (gnats) and a few Coleopterans (water beetles) crustaceans and some frogs in these streams.

In this paper an account is given of the ecological factors that govern fish life in the various types of habitats. The number of specimens with measurements with the list of species collected therefrom are also given.

ECOLOGICAL OBSERVATIONS AND LISTS OF SPECIES

Kalikayam Stream:—The Kalikayam stream, which passes through the Balamoore area, is about 40 feet wide with an average depth of about 2½ feet

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*Geographically and faunistically conditions in Malabar, Cochin and Travancore are more or less identical.

and has a rocky bottom with a number of pools along its course. During the time of collection in April its water was clear. The largest pool in its course has a surface area of about an acre and the flow beyond this pool was moderate. Collections of fish were made from the pools as well as the running stream.

The following species were collected from the pools :—

Name of species	Number of specimens	Standard length in millimeters
Barilius bakeri Day ...	9	42–78
Barbus (*Puntius*) *filamentosus* (C. & V.) ...	4	26–5
Barbus (*Tor*) *khudree malalaricus* (Jerdon) ...	10	76–87
Garra mullya (Sykes) ...	8	48–91
Aplocheilus lineatus (C. & V.) ...	6	22–36
Ophicephalus gachua (Ham.) ...	1	47
Mastacembelus guentheri Day ...	3	137–172

The following species were collected from the running waters :—

Species	Number of specimens	Standard length in millimeters
Barilius bakeri Day ...	14	35–86
Danio aequipinnatus (McClell.) ...	38	26–61
Barbus (*Puntius*) *melanampyx* Day ...	16	27–46
Garra mullya (Sykes) ...	4	43–73
Nemachilus triangularis Day ...	6	33–66.5
Batasio travancoria (Hora & Law) ...	5	88–93
Mystus cavasius (Ham.) ...	1	39
Mastacembelus guentheri Day ...	2	38–119

Thadikarakonam Stream :—In addition to rocky rapids and pools, the stream at Thadikarakonam had intermittent patches of muddy areas along its course. There was overhanging vegetation on either side of the stream. The banks in some places were covered with aquatic and semi-aquatic vegetation. Accumulations of fallen and decaying leaves were present in shallow places along the sides of the stream. Stagnant water isolated here and there in crevices and depressions of the rocks formed excellent breeding grounds for mosquito. Separate collections were made from the pools, running water and muddy areas along the course of the stream.

The following were collected from the pools where the flow of water was very slow :—

Species	Number of specimens	Standard length in millimeters
Danio aequipinnatus (McClell.) ...	9	22–45
Barbus (*Puntius*) *melanampyx* (Day) ...	8	20.5–38
Barbus (*Puntius*) *amphibius* (C. & V.) ...	1	43.2
Aplocheilus lineatus (C. & V.) ...	5	17.5–34

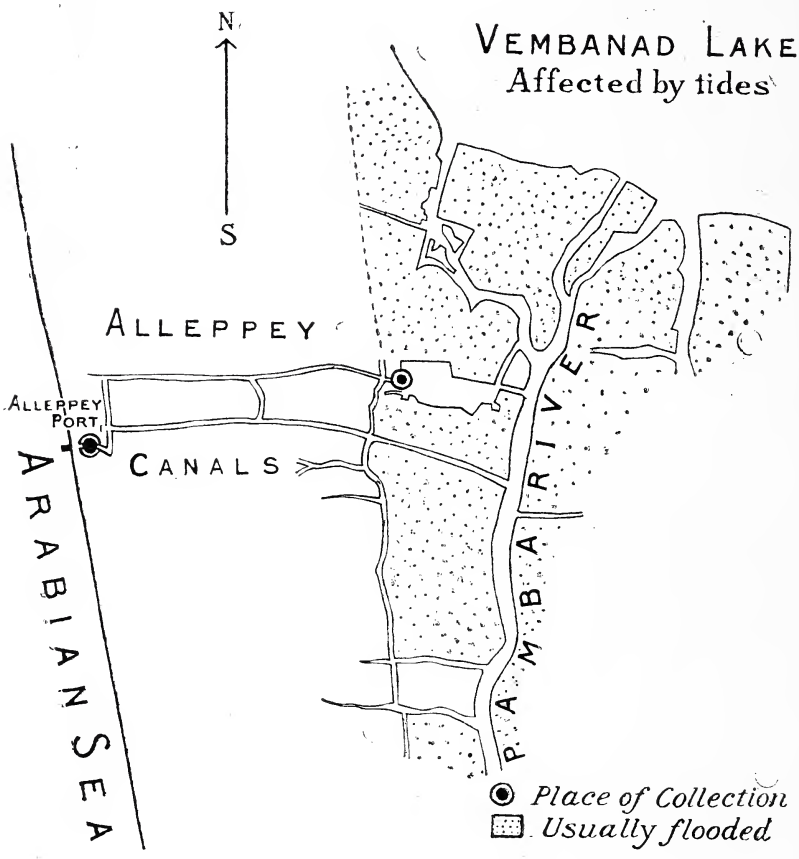
The following were collected from moderately running waters :—

Species	Number of specimens	Standard length in millimeters
Danio aequipinnatus (McClell.) ...	11	21–47
Rasbora daniconius (Ham.) ...	1	67
Barbus (*Puntius*) *melanampyx* (Day) ...	9	21–36
Barbus (*Puntius*) *dorsalis* (Jerdon) ...	3	32–26
Barilius bakeri Day ...	1	27
Garra mullya (Sykes) ...	1	29

The following were collected from muddy areas :—

Species		Number of specimens	Standard length in millimeters
Garra mullya (Sykes)	...	1	59
Aplocheilus lineatus (C. & V.)	...	2	24 & 49
Ophicephalus gachua (Ham.)	...	4	36.5–68

Alleppey Canals :—A collection was made from the canal system in Alleppey town which consists of three interconnected parallel canals starting from the Vembanad lake and the Pamba river (fig.). The water in these canals is



subject to tidal influence to a considerable extent as a result of which their salinity is greater towards the lake end than towards the blind ends. The salinity is highest during the summer months when the freshwater outflow from the rivers into the lake is less. The rich aquatic vegetation and micro-phyto-plankton present in these canals give plenty of food, shelter and shade for the fishes. In some places the overgrowth of the water-hyacinth (*Eichornia crassipes*) results in the death and decomposition of the submerged vegetation and the water in such places becomes impure—a condition not congenial for normal fish life. But hardy air-breathing forms, such as, *Anabas testudineus*,

Ophicephalus gachua, Ophicephalus striatus, Heteropneustes fossilis, etc., are found to live in such places.

According to the degree of the salinity of the water the fishes collected from the canals can be arranged into two groups, namely, those collected from places near the mouth of the canal where the salinity is greater, and those collected towards the blind ends of the canal where the salinity is very low.

The following were collected from near the mouth of the canal :—

Species	Number of Specimens	Standard length in millimeters
Lutjanus argentimaculatus (Blkr.) ...	3	65–73·5
Synaptura orientalis (Day.) ...	5	93·5–98
Paraplagusia bilineata (Blkr.) ...	1	99
Equula edentula (Bloch) ...	1	35
Ambassis thomasii (Day.) ...	7	48–53
Ambassis dayi (Blkr.) ...	5	39·5–44
Glossogobius giuris (Ham.) ...	6	61–152
Heteropneustes fossilis (Bloch) ...	3	207 214
Anabas testudineus (Bloch.) ...	2	114 & 119
Ophicephalus striatus (Bloch) ...	1	124
Etroplus maculatus (Bloch) ...	48	30–54·5
Etroplus suratensis (Bloch) ...	4	71–73
Mastacembelus gentheri (Day.) ...	3	219–224
Elops saurus (Linn.) ...	1	107
Scatophagus argus (Bloch) ...	2	47–55

The following were collected from towards the blind end of the canal :—

Species	Number of specimens	Standard length in millimeters
Ophicephalus striatus (Bloch) ...	2	175 & 220
Etroplus maculatus (Bloch) ...	30	29·5 to 58
Etroplus suratensis (Bloch) ...	6	68–72
Barbus (*Puntius*) *pinnauratus* (Day.) ...	3	138·5–144
Barbus (*Puntius*) *amphibious* (C. & V.) ...	4	65–89
Barbus (*Puntius*) *filamentosus* (C. & V.) ...	6	55–67
Amblypharyngodon melettina (C. & V.) ...	1	79
Mystus oculatus (C. & V.) ...	2	91–108
Mystus vittatus (Bloch) ...	36	88–104
Glossogobius giuris (Ham.) ...	5	83–170

General Observations on the Collection

In all 370 specimens were collected, which include 33 species belonging to 23 genera and 16 families. Many of the species listed above are common and widely distributed and hence they need no special remarks. *Barbus* (*Puntius*) *dorsalis* (Jerdon) collected from the Thadikarakonam stream is recorded from Travancore for the first time. Besides, the range of *Batasio travancoria* is extended within the limits of Travancore.

Notes on some of the species are given below :—

Barbus (Puntius) dorsalis (Jerdon).

Barbus dorsalis, Hora, (1936) *Rec. Ind. Mus.* xxxviii : 1-7. 3 specimens. Length 34 to 42.2 mm.

Stream at Thadikarakonam, South Travancore.

Barbus dorsalis is a new record from Travancore. The specimens showed the following characters :—

The dorsal fin starts in front of the ventral and is midway between the end of the snout and the base of the caudal fin. The dorsal spine is weak and not serrated. Upper 2/3 of the body is slightly darker. All the scales are dotted with fine black spots, the spots being denser towards their bases. There is a deep black spot at the basal portions of the dorsal starting from the fifth ray

and extending backwards. A similar spot is also present at the centre of the base of the caudal fin on each side. This species does not attain large size.

The variations in the colour of the body found during growth has been the main reason for its being described under different species by various authors. This aspect has been pointed out and clarified by Hora (1936) who has given a series of figures showing these variations in three main types of coloration along with the transitional stages. Very young specimens measuring about 23 mm. show a dark spot each at the base of the dorsal, caudal and anal fins. In specimens measuring about 34 mm. the anal spots disappear, but the dorsal and the caudal spots which persist are very distinct. These spots become reduced and lighter in specimens measuring more than 83 mm. The specimens under observation resemble the 34 mm. stage described by Hora.

The measurements of the specimens in millimeters are as follows:—

Total Length	...	34	40·5	42·2
Length of caudal	...	8·5	9·2	10·1
Length of head	...	7·1	8	9·8
Height of head	...	5	5·3	6·3
Width of head	...	4	5	5·1
Depth of body	...	7	8·5	9·5
Diameter of eye	...	2	2·5	2·5
Length of snout	...	1·8	2	2
Interorbital distance	...	2·5	3	3
Length of dorsal	...	7·1	8·5	9
Length of pectoral	...	5·5	6 8	7
Length of anal	...	5	5·5	6
Length of caudal peduncle	...	3·8	4·9	5
Least height of caudal peduncle	...	3·2	4·2	4·5

Barbus (Puntius) pinnauratus (Day).*

Barbus pinnauratus. Hora and Law, (1941) *Rec. Ind. Mus.* xliii: 247.
4 specimens. Length 138.5 to 144 mm.
Canals in Alleppey, North Travancore.

Cuvier and Valenciennes (1849)[1] described a specimen collected from Alleppey as *Barbus gibbosus.* Topotypes obtained from the same locality by the writer resemble Day's description of *Barbus pinnauratus* in all essentials. Hence this helps to confirm that *Barbus gibbosus* is a synonym of *Barbus pinnauratus.*

Batasio travancoria Hora and Law.

Batasio travancoria. Hora and Law, (1941) *Rec. Ind. Mus.* xliii: 40-42.
5 specimens. Length 88-93 mm.
Kalikayam stream—South Travancore.

Hora has described specimens collected from Perunthenaruvi, Kallada river, and Kulathupujha in Central Travancore and River Palode, north of Trivandrum. The present collection shows its extended distribution to the south. The nearest related species of this genus are found in widely separated areas.

Acknowledgement

I am deeply indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for all the facilities he gave me to work out the collection and for his kind encouragement and guidance.

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*=Barbus (Puntius) sarana (Ham.).

[1] *His. Nat. Poiss.* Cuvier, M. B. and Valenciennes, M. p. 154 (1849).

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REVIEW

1. ANIMAL LIFE. By J. R. Bhatt. Pp. iii + 253, $8\frac{1}{2}'' \times 5\frac{1}{2}''$—The Ceylon Daily News Press, Colombo.

Books on animal life for use in schools are many; only a few of them rise above the level of mediocrity so characteristic of our school text books. This book on 'Animal Life' by Mr. J. R. Bhatt is a welcome departure from routine texts prescribed for study. It does not claim to be a standard text-book nor does its author aim at an exhaustive treatment of the subject matter. Yet, one finds in it a harmonious blending of theoretical with practical knowledge and therein lies its uniqueness. Although the book deals with the outlines of structure and the life-histories of common animals with particular reference to Ceylon, it may well be followed as a model in our schools.

The first few chapters are treated in a simple and lucid manner in order to acquaint the young student with the life-histories of common types of animals. Practical hints are given at the beginning of each chapter along with questions to test the power of observation of the student. These are so framed as to incite curiosity and create enthusiasm to know more about the mysteries of animal life in a state of nature. This attempt of the author, to engender in the readers interest, initiation, observational powers and correlation of facts observed, deserves credit. His approach to the subject is the right one and every teacher would do well to follow the methods adopted by Mr. Bhatt.

Another notable feature of the book is the gradual emphasis that the author lays on the bearing of animal life on human economy and the applications of the science to agriculture and animal husbandry. In fact, side by side with natural history, the reader gets some idea of applied zoology designed to stimulate, in young minds, interest in biological problems such as the improvement of live-stock, eradication of pests of food-crops, elimination of disease producers and disseminators and the development of cottage industries.

The book is fairly well illustrated although additional diagrams and plates would have enhanced its value. It should prove useful in the schools to the teachers as well as students, not only as a guide for studies but also as an introduction to more advanced study of the mysteries of animal life and their bearing upon human affairs.

N. N. Murti.

2. POPULAR HANDBOOK OF INDIAN BIRDS. By Hugh Whistler, F.Z.S., M.B.O.U., Fourth edition. Illustrated. Gurney & Jackson, London 1949. Price 22*sh.* 6*d.*

Vagaries and exigencies of the printing trade and the untimely death of the author in 1943 have held up and dragged out the publication of the fourth edition of this excellent and much-sought book till now. The delay has been unfortunate since the large number of bird students, mostly British and American military personnel, who were concentrated in India during the war were forced to remain disappointed and greatly handicapped by the book being then out of print and unobtainable. But though it undoubtedly missed the best market from the sales point of view it is not rendered the less welcome now that it has appeared. Happily there is still a considerable number of discriminating bird enthusiasts in this country who have waited eagerly for its appearance all these years and who will now acclaim it with genuine satisfaction.

The book has been revised and enlarged by the addition of some extra illustrations and text by Mr. Norman B. Kinnear [at one time Curator of our Society and now Director of the British Museum (Natural History)] who was a constant collaborator with the late Mr. Whistler in some of his most important systematic work on Indian birds.

The present edition contains 24 full page plates (instead of 21) of which there are 7 in colour in place of 6 previously. Three extra figures have been added in the text. The inaccurate drawing of the Yellow-cheeked Tit on

page 23 of the 3rd edition has been replaced with a truer likeness of the bird. All the new drawings are the work of Roland Green, well known as an illustrator of many modern bird books.

Sundry minor changes following the suggestions of reviewers of previous editions, and the addition of the following species considerably enhance the usefulness of the book :—*Siva strigula* and *Siva cyanouroptera, Ianthia cyanura, Niltava sundara* and *N. grandis, Pyrrhula erythrocephala* and *P. nipalensis, Merops leschesaulti* and *Alcemerops athertoni, Coryllis vernalis, Macropygia unchalla.*

Members will be pleased to learn that in future copies will be available from the office of the Bombay Natural History Society.

S. A.

3. THE ALL-IN-ONE SHIKAR BOOK. By Maurice Tulloch. Published by D. B. Taraporevala & Sons Ltd. Bombay. Price Rs. 10.

This book, as its name implies, is a compendium of information on all branches of shikar, and fulfils a long-felt want at a most reasonable price. Chapter 1 gives in simple language details of shot guns, which might be read with advantage by those dealers who refer in their catalogues to 12 bore, not apparently realising that the decimal point is applied to rifles only. In the paragraph on cartridges emphasis might have been laid on careful storage in air-tight boxes in places where the monsoon is heavy; with this precaution they seem to keep almost indefinitely. On the question of shot sizes, the author is, we think, undoubtedly correct in his preference for the smaller, on account of the better pattern. Even for duck we have found that No. 7 or 8 kills dead, and that large shot too often results in wounded (and generally lost) birds. Much of course depends on the angle at which the bird is taken, and whether driven or walked up. It would for instance be of little use, as well as cruel, to fire with No. 8 shot at a peafowl going away, though the bird may be killed dead with the same size when driven overhead. No. 7 is probably the most suitable for all-round purposes, but it has not been available for some years, and the best solution seems to be No. 8 in the right barrel and No. 6 in the left for general purposes. It would simplify matters when reloading if different sizes of shot were distinguished by cases of different colours, as in pre-war days.

Chapter 2 gives useful instruction on how to shoot, and emphasis is rightly laid on the importance of foot-work. The necessity for that clumsy contrivance, the cross-eyed stock, when the left eye is master, seems however to be doubtful. Our own experience is that the defect can be corrected with glasses. The effective killing range of shot guns might have been mentioned. Far more game is shot under 25 yards than over, and 40 yards is definitely a long shot.

The chapter on 'Safety' is of the utmost importance, not only for beginners but also for those of more experience, who were not trained correctly in their youth. How often one has seen men climb over an obstacle without unloading, or handing their gun to the shikari without first removing the cartridges! Page 16 shows how a gun should be carried, but it should be noted that when carrying the weapon in the crook of the arm, it is essential that the safety catch should be on, otherwise a rough sleeve may cause an explosion by catching at the trigger.

In the chapter on snipe, the author states that Pintail is smaller than the Fantail, but our experience is the reverse, the Pintail being a noticeably heavier bird. The paragraph on marking down is admirable, and if carefully observed should result in very few lost birds. At times a dead bird may be walked over, and in such cases it pays to form a close line working to and fro over the suspected spot. If this fails to produce the bird, the probability is that it has been trodden into the mud. A few other points perhaps deserve mention. In snipe shooting balance is all-important, and this can be achieved only if the left foot is kept constantly leading. When a bird rises very close, it is better not to raise the gun till it has got to a reasonable distance—any attempt to follow it almost invariably results in a miss. A bird which you think you have hit, and which does not rise appreciably above the line of sight as it goes away, should be marked down even though it carries on for some distance—the chances are it will be found dead. The drawings of duck in chapter 6 are helpful, though the Pintail Duck might be better described as

brown rather than grey and black. The edibility of ducks depends very largely on their food. In some places the Whistling Teal may be quite good eating, and the Pintail incredibly fishy. Even the Brahminy and Shoveller are not too bad if skinned instead of being plucked. Incidentally the Shoveller is not a dirty feeder in South India as it is in the North. For shooting an open tank, a length of wire netting into which grass and reeds can be quickly woven, supported on light bamboos, makes an admirable hide, and is easily transportable. If one has no hide, it pays to lie flat on one's back in the open at the water's edge. Both duck and geese pay little attention to one in this position.

Chapters 7 to 9 call for no remarks, except that an error has crept in on page 45 regarding the Greater Bustard. It is the cock and not the hen which is the larger bird.

Chapter 10, The Sportsman's Code, is a most valuable one, for here at last is laid down in black and white what constitutes good sportmanship, and no one can any longer offer the paltry excuse of ignorance. It deserves the closest attention of all sportsmen, for there can unfortunately be no doubt that the standard of sportsmanship has greatly deteriorated in recent years, and for the beginner it should prove specially useful, since only too often he has no guide on the subject except the local shikari, who naturally is interested solely in the size of the bag. The standard laid down in this Code is not impossibly high, and everyone calling himself a sportsman should observe it. The obligation not to fire at a dangerous animal unless one is prepared for a possible follow-up, is of special importance, and with it one might couple the heinousness of firing from a car.

Chapter 11 gives sound advice on different types of rifles and how they should be used. The old-fashioned Express of .500 or .577 bore with L.P. cordite, is a most useful weapon for tiger, provided solid bullets are used, and not hollow-pointed which are liable to break up without penetrating. The chief trouble with these rifles is the difficulty of obtaining ammunition.

Tyros will find the chapter on fieldglasses useful, but perhaps more emphasis might have been laid on the importance of a telescope for hill shooting, to assess a distant head, which fieldglasses alone cannot do.

The chapters on big game are sound and call for little remark. The drawing on page 78 to illustrate sitting-up is artistic, but ignores the necessity for all-round cover, so essential in this type of shikar. As to the ethics of sitting-up, we consider the author's remarks fully justified. A shallow purse or jungles which cannot be beaten owing to the terrain or lack of men often prohibit the more normal method. That it should be illegal in some parts weighs the balance in favour of those who can command a line of elephants. In other places beating is prohibited!

As regards bison, the statement that a wounded bull will circle on his tracks, is contrary to the experience of most sportsmen. The question of soft-nosed or solid bullets depends not only on the angle at which the shot is taken, but also on the bore of the rifle. A soft-nosed .470 bullet will probably prove more effective than a solid from a low-power rifle like the ordinary .375.

For crocodile shooting a telescopic sight makes all the difference with such a small target as the neck or brain affords, and it is also worth remembering that even if a wounded mugger succeeds in reaching the water, there is a chance that he will be so worried by water entering the wound, or by small fish nibbling at it, that he will return to land within a short time and offer a second chance.

Chapter 27 on Fishing, is, as the author says, somewhat elementary, but that is what makes it specially valuable. A simple explanation like this of the various forms of fishing should encourage men to take up this fascinating sport, who in the ordinary course might shy off a regular fishing book, or who are obsessed with the idea that fishing is too technical or requires a bottomless purse and endless patience before success can be attained.

The author is to be congratulated on having produced a book so full of really useful information on all branches of shikar, and so very pleasant-illustrated. It is the best ten rupees worth which has come on the market for very many years, and should be in every sportsman's library.

E. G. P.-A.

4. INSECT DIETARY. By Charles T. Brues. Harvard University Press, Boston, Mass: U.S.A.

This is the first complete work of its kind that I have read and is most instructive, covering the whole range.

Copious references and full index are included and should be of great value to all entomologists, particularly those engaged in the study of 'controls' and I strongly recommend it to students because of its completeness.

A reference to Phoridae on page 201 reminds me of some disappointing experiences in relaxing and setting choice specimens of the Lepidoptera group here in India and I strongly advise collectors to beware of this pest.

An interesting robber is described in the Wax Moth, quite a harmless and somewhat pretty insect.

Penicillium and other moulds have attention. Also the unwelcome clothes moth.

The section dealing with predatory insects is very interesting and describes some surprising examples, one deserving special mention is *Rodolia cardinalis* and its food *Icerya purchasi;* this ladybird has been specially bred at the Entomological station at Kodaikanal, South India for control of the *Icerya* pests on the Acacias and results have been very satisfactory; specimen tubes have been presented to the Bombay Natural History Society by that station.

Figure C on plate XIV shows a very useful control of that terrific defoliator the Gipsy Moth which reminds me of a special visit I paid in 1941 to the Kangan Willow plantation at the request of the Forest Department of the then Jammu and Kashmir Government.

Personal observations of Asilidae in this country are recalled by the references on Page 267.

The section dealing with Parasites is particularly interesting and surpasses my lengthy experience; I am sure all readers will enjoy this section and I hope I am not too optimistic in anticipating a complete mounted collection of hosts and parasites of Indian groups for the Museum for the benefit and guidance of all who follow in the steps of the former famous entomologists who made entomology known in India.

After several readings I feel I have only skimmed the surface of this wonderful book but take my advice, read and enjoy it.

J. I. ALFREY, F.R.E.S.

MISCELLANEOUS NOTES

1.—TIGER EATING PANTHER.

With reference to Lt.-Col. E. G. Phythian Adams's note in the April 1949 *Journal* I have referred, in earlier issues to two cases of tiger attacking panther that had the temerity to feed on the tigers' kills. In the first instance I was sitting up over a tiger kill when along came a panther which I shot. The tiger turned up an hour later, caught sight of the panther; and immediately stalked and leaped on it. Having duly killed the panther as it no doubt thought, the tiger then proceeded to drag it away, presumably to make a meal of it. I then intervened, wounded the tiger, and later recovered it.

In the second case a tiger killed a cart bull on our main ghat road, and dragged the kill into the jungle. The tiger later came on a panther eating the kill and killed and devoured most of the panther.

Now, the third case within my knowledge occurred in April this year. A very hungry tiger that had, unsuccessfuly, been endeavouring to kill bison(both a solitary and from a herd) eventually took a bait. After having been missed twice by a guest and alarmed by the light thrice (in five approaches to the kill in one night) the tiger returned again 3 or 4 nights later to a very decomposed kill. Just prior to its arrival however a panther rolled up, 'sawing', and was shot. The tiger came about half an hour later merely pushed the panther aside, and got down to eating the putrid flesh of the kill, being now ravenous. Whether the tiger would have turned its attention to the panther later I am unable to say; but I think this probable. What *was* remarkable however is that the tiger appeared to recognise that the panther was no longer in a position to feed on the kill; otherwise, judging from the first two cases, the tiger would hardly have left the panther lying there.

HONNAMETTI ESTATE,
ATTIKAN P.O., (VIA MYSORE), COL. R. C. MORRIS.
15th September, 1949.

2.—AMBUSH TO CAPTURE CROWS BY YELLOW-THROATED MARTEN (*CHARRONIA GWATKINSI*)

I witnessed a most extraordinary sight the other evening, which I think might interest you.

I was sitting on a rock at the edge of the grassland overlooking a big patch of scrub, hoping to get a shot at a pig. At about 6 p.m. a very large flock of crows (I counted up to 100 of them) flew over me at a height of about 50 feet. As they passed

they started to circle over a spot about 50 yards beyond me. At first I thought I was the centre of attraction, but after a minute or two I realized that they were interested in something further along the ridge. I moved up very quietly and saw a blackish object moving about on top of a big flat-topped boulder out on the grassland. I got my glasses onto it and saw what appeared to be an orange-throated marten. He was rolling about on his back rather sluggishly. The crows were now alighting on several rocks round about, cawing, and in a great state of excitement. Suddenly three or four crows which had been sitting on a group of rocks nearby, rose in the air making a tremendous commotion. I got my glasses onto this rock and saw one crow flapping about there in its death agonies, with another marten holding it in its teeth.

The main body of crows had by now all taken to the air, and after a good deal of chatter, flew on to their roosting place. At this the marten which had been rolling about got off his rock and ran to join the animal which had killed the crow. Very shortly afterwards they were joined by a third marten which appeared to come from another group of rocks. After a bit of bickering they settled down to pull the crow to pieces and eat it.

I think there can be no doubt but that this was an organised ambush for the crows, which flight every night on this line. The marten which I saw first was obviously the decoy, and the other two which had been lying in hiding were the attackers.

I got up and approached the martens so as to get a good view of them as they moved off. They saw me almost at once, but were very loath to leave the kill. After some chittering they ran down the grassland past me—I was between them and the shola—and I got a very good view of them.

The colour all over was a very dark brown, except for the throat, which was a brilliant orange. A very long thin body, with a slim, pointed head. The tail very long and not very bushy.

I had never seen one of these animals before but I think they must have been orange-throated martens.

I had a look at the scene of the kill afterwards, and found patches of old crow's feathers in various places round about. I wonder if this is a daily procedure; it obviously had been done before the day on which I observed the spectacle as well.

GUDERALE ESTATE,
MUNNAR P.O., C. J. GOULDSBURY
TRAVANCORE,
17th September, 1949.

3.—CHARGE BY UNWOUNDED BISON

Lt.-Col. Phythian Adams's note on the above subject is of interest, the incident having occurred only 4 months before a somewhat similar experience which befell myself and a guest. I have already sent the Society a note on the occurrence which will

presumably appear in the next number of the *Journal*[1], so I need not go into the details again.

R. Unwin, in an interesting article in the *Planters Chronicle* recently, referred to the death of a young friend in the Geological Survey in Burmah (before the War). He was examining the steep banks of a very narrow stream and, round a corner came on a bull bison. To drive the animal away he threw stones at it and was promptly charged and killed. Possibly the bull had been fighting; or it may have imagined itself being driven into a cul-de-sac. Either may have been the cause of its exceptional behaviour. Years ago I was charged by a bull immediately on downing another larger bull near it. In self-defence I had to shoot the aggressor, and then found it had been badly mauled by a tiger some days previously. The wounds were septic and maggot-ridden.

HONNAMETTI ESTATE,
ATTIKAN P.O. (VIA MYSORE), COL. R. C. MORRIS
15th September, 1949.

4.—HOW DO PREDATORS KILL PORCUPINES?

Porcupines, by virtue of their formidable armature of sharp quills would appear to have few enemies in the forest. Most animals, not excluding tiger and panther seem to have a healthy respect for them. Yet, the tiger, panther and the lesser cats are known to prey upon them regularly. Exactly how this is done still remains an enigma.

A conjecture is however contained in an article by H. B. Gabb in the 'Field' for April 1945. While out shooting porcupines in the Darjeeling district, Gabb's shikaris took him to a porcupine's cave on the side of a hill. Close to its main entrance there was a bolt hole above and a little to the side. Arranging with his men to light a fire in front of the entrance with a view to smoke out the occupants, he took up position close by. Strange sounds soon began to emanate from the cave. Peering into it through the clearing smoke, he saw the crouching figure of one of those rare felines—a clouded leopard. He shot it and upon dissection its stomach was found to contain porcupine meat. A few days later, walking past the same spot and looking in he found the dead body of a second clouded leopard with its tail hanging out of a crevice in the cave. Dislodging it with difficulty he found it to have been dead some days having presumably been smoked to death inside the cave. Evidently the animals were hunting in concert, one entering through the main entrance to draw the porcupine's fire, while its companion crept in through the bolt hole to attack it on the head, the animal's most vulnerable point during its backward rush.

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[1] Published Vol. 48, p. 578.

Is this, then, the normal *modus operandi* adopted by predators to circumvent the porcupine? Observations from readers on this point would be welcome.

114, Apollo Street,
Fort, Bombay, EDITORS
12th October, 1949.

5.—NOTES ON THE INDIAN PANGOLIN (*MANIS CRASSICAUDATA*, GEOFFER St. HILAIRE)

A specimen was obtained (by a friend) alive in the Nilgiris at 7,000 feet and brought to the Anamallais to 3,000 feet where it survived for three days.

It drank a little water and ate some carrot tops but would not touch white ants (termites). It would not drink milk or eat cooked rice.

It was extremely active and climbed all over the chairs in the sitting room. After it died it was given to me as I asked for it to mount it in my collection.

Measurements.

Length total 35″.
,, of tail to vent 15″. *Weight.* 10 lb. 2 oz.
,, of tongue 12″. *Sex.* female.
,, of forelegs $3\frac{1}{2}$″.
,, of backlegs 4″.
,, of claws (forefoot) . . . $\frac{1}{4}$″, $1\frac{1}{2}$″, 2″, 1″, $\frac{1}{2}$″ (5 claws)
,, of ,, (backfoot) . . . $\frac{1}{4}$″, $\frac{1}{2}$″, $\frac{3}{4}$″, $\frac{5}{8}$″, $\frac{1}{2}$″ (5 ,,)
,, snout to eye . . . $2\frac{1}{2}$″.
,, eye to ear . . . $1\frac{1}{4}$″.
Girth at midbody . . . 20″.
,, of tail at base . . . 12″.
,, of neck behind ears . . . 8″.

Sharp scales at sides of tail: 16 on each side. Scales from tip of tail to forehead: 46. Longest scale (on back at root of tail $2\frac{3}{4}$″ × 2″.

Colour. Sandy grey above and buff below on the fleshy parts. Centre of scales darker. Scales at side of tail brownish.
Tongue. Purple.
Eyes. $\frac{3}{16}$″ olive and green-grey.

Stomach contents consisted of 20 stones, some $\frac{1}{4}$″ diam., with some vegetable matter.

Intestines contained remains of black ants, beetle wing sheaths, remains of cockroaches and what appeared to be the leathery skins of grubs and worms.

Anal gland contained $\frac{1}{4}$ oz of evil smelling yellowish fluid which smarted like iodine on coming into contact with a wound (cut finger). Under nearly every scale there were ticks of several

kinds the longest some $\frac{3}{4}$" in size. The fleshy under-parts were slightly hairy. Most of the scales had a hair or two sticking out from underneath.

Injipaarai Estate,
Valpara P.O.
Via Poolachi,
Coimbatore Dist.,
26*th September*, 1949.

ANGUS F. HUTTON

6.—WHITE-CAPPED REDSTART [*CHAIMARRHORNIS LEUCOCEPHALUS* (VIGORS)] FEEDING ON BERRIES.

On October 1st, 1949, at Sahiya, below Chakrata, U.P., at a height of 3,500 feet, while the bus was waiting for the gate to be opened, my companion, Rev. John Bishop, noticed a White-capped Redstart by the stream. We watched it for some time, flycatching in the orthodox manner of the species, but it then flew up into some overhanging bushes and we saw it twice settle in a bush, possibly a *Berberis* of some kind, and pick off and swallow a berry. Mr Sálim Ali, following other authors, says in his new book, "Indian Hill Birds" that its food consists entirely of aquatic insects. One is almost tempted to suggest that this bird, having become aware of a change of political regime in India, was trying to impress on two western observers the importance of adapting one's food habits to the environment.

24, Rajpur road,
Delhi,
10*th October*, 1949.

H. G. ALEXANDER

7.—THE VALIDITY OF *HARPACTES FASCIATUS LEGERLI* KOELZ

In the Proceedings of the Biological Society of Washington [52, (June 5, 1939): 79] Dr. Walter Koelz described, on the strength of a single specimen collected by him in Orissa, a new race of the Malabar Trogon as follows:

'*Harpactes fasciatus legerli,* new subspecies.

Type: Adult [♂] collected in the forests at the foot of Mahendragiri, Orissa, on January 22, 1937, by W. Koelz.

Differs from *malabaricus* in my collection from Londa, Bombay Presidency, the Malabar Coast, and the Nilgiris, in being paler, especially on the back and in having the white of the wing barring more extensive. The wing may average longer. In the single specimen it measures 130.5 mm., while in 20 specimens from the Western Ghats only one has so long a wing.'

In the absence of adequate material from the eastern side of the peninsula it was difficult to assess the value of the characters given and Dr. Koelz's airy statement that 'the wing may average longer' did not tend to add to the readiness of ornithologists to accept the new race.

Peters in his Checklist of the Birds of the World [V (1945): 161] synonymises *legerli* with *malabaricus* whose distribution he defines as follows: 'Western India from Khandesh to Travancore, east to the Wynaad, the Nilgiri and Nelliampathie Hills; also recorded from Western Bengal south to the mouth of the Godavari River.'

Recently I have been able to collect series of trogons both in the Surat Dangs (c. 21° N × 73° 30′ E), an area of hilly moist deciduous forest country at the northern extremity of the Western Ghats, south of the Tapti River, and also in Bastar District, Central Provinces, in biotope more or less topotypical of *legerli*, at the same latitude as Mahendragiri in Orissa but about 200 miles westward of that locality.

Measurements[1]:		Wing	Bill	Tarsus	Tail
Bastar	1 ♂	133	20	15	180
	2 ♀♀	125–128	19(1)	16(1)	143–169
Surat Dangs	12 ♂♂	130·5–142	19·5–21·5	15–17	155–184
	6 ♀♀	130–135	18·5–21	15–17(3)	160–176·0
As against the above					
Travancore	±7 ♂♂	122–129	20–23		160–179·5

The Bastar birds, although not showing more extensive white wing barring, clearly belong to the population described by Koelz from Mahendragiri, Orissa, and to my mind amply justify recognition of his race *legerli*. As compared with birds from Travancore and Kanara they average larger in the wing (thereby confirming Dr. Koelz's inconsequential conjecture!) and are brighter in coloration. In these particulars they agree fairly well with the good series from the Surat Dangs thus extending the distribution of *legerli* to the western side of the peninsula, presumably over the Satpura trend.

It will be recalled that Mr. Whistler remarked [*J.B.N.H.S.*, 38 (i): 29] on 3 Khandesh specimens in the British Museum collection (one collected by Davidson in the Dangs) that they were markedly paler than Malabar birds but that he was not satisfied about this difference being subspecific.

Between the male from Bastar and those from the Dangs there is no difference in coloration above or below. As compared with Travancore and Kanara birds these examples are a brighter *yellowish* brown above, less suffused with chestnut particularly on the upper tail coverts. The breast is more sooty black or greyish-black as against deep black in southern specimens.

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[1] As the Surat Dangs and Bastar specimens were measured in the flesh, 2 mm. may be taken off the wing length for comparison with dry museum skins.

In both the Bastar females, however, the upper back has a darker olive tinge making it more or less concolorous with the head and contrasting with the bright rufous-orange of the rump and upper tail coverts. In females from the Dangs, while the upper back is sensibly darker than the rump there is a distinct contrast between it and the much darker olive-washed head and nape. Dangs birds are clearly a stage in the colour cline between Travancore birds (*malabaricus*) and Bastar examples (*legerli*), but seem closer to the latter.

For the sake of convenience I would now arbitrarily define the distribution of *malabaricus* as 'the Western Ghats country north to the 20th parallel'. Individual specimens from about the Bombay neighbourhood would pass with either race.

33, Pali Hill, Bandra,
Bombay, SALIM ALI

10*th November*, 1949.

8.—THE INDIAN BUTTON QUAIL (*TURNIX MACULATUS*): A NEW RECORD FOR BOMBAY

At about 10 o'clock one night at the end of May, as we walked into Nazaz Restaurant on Malabar Hill, a small bird flew in from the opposite side of the building, hit the ceiling and fell to the ground. It may be remembered that the rains had started on May 23rd and on the night in question there were heavy showers accompanied by thunder and lightning. The bird had obviously been frightened by the storm, and was so dazzled by the lights and bewildered by its unaccustomed surroundings that it was an easy matter to catch it and carry it home for identification. A casual glance showed that it was a quail of sorts, and the fact that it had only three toes pointed to the fact that it must be either a Button or a Bustard-quail. This narrowed down the search considerably. The chief characteristics of our bird were its broad collar of chestnut, and its yellow beak and legs. On consulting Whistler's Handbook of Indian Birds, under the heading of Little Button-Quail, we found the following note: 'The male of the Indian Button-quail (*Turnix maculatus*) is very like the Little Button-quail, but has a yellow bill and lacks the long pointed tail feathers. The female is distinguished by a broad rufous collar.'

We tried for some days to keep the bird in captivity in a large wire cage, but it was wild and injured itself so badly by dashing against the wire that we were obliged to release it when it flew straight away. It was suggested that the bird might have been one which had escaped from captivity, but its extreme wildness and the strong desire it showed to escape from the cage

seemed to negative this idea. As the Indian Button-quail is not included in the list of birds in 'The Birds of Bombay and Salsette' I should be interested to know if this is a new arrival in Bombay?

53, St. Paul's road,
Bandra, Bombay, DORIS FERREIRA

19*th August*, 1949.

[This quail is fairly well distributed throughout India, but there is no previous record from near Bombay. Butler shot it near Poona (Hume & Marshall II, p. 187) and Major W. B. Trevenen also lists it among the birds shot at Poona but without comment (*J.B.N.H.S.* Vol. XXVIII, p. 1081) —Eds]

9.—KENTISH PLOVER [*LEUCOPOLIUS ALEXANDRINUS* (LINN.)], BREEDING ON WEST COAST OF SAURASHTRA

Although I had visited Porbunder before, I had not spent much time along the coast. Last hot season, from May to July 1949 at Porbunder, gave me enough time to study the shore birds, and I was glad to find the Kentish Plover (*Leucopolius alexandrinus*) breeding fairly freely there and on the coast, in small numbers. Actually, near Navibandar there were quite a number of small congregations of these plovers, but only sporadic pairs were found breeding just above the high tide level. It seems a common occurrence for their nests and eggs to be lapped by the high tides. Both sexes incubate a clutch of 2 to 3 eggs. Some eggs have a greenish tinge. The nesting site varies from hard rugged limestone to dry soft sand of the typical dune. When the nest is approached both parents try to sham injury, however, sometimes, only one parent bird is seen. The birds become very worried when one is very close to the nest. This ruse of feigning injury was the attraction of a very unusual incident which happened on May 18th at Gossabara, while watching one of a pair of the Large Stone-Curlew (*Esacus recurvirostris*) which was feeding. Although at fairly long distance I suddenly noticed the appearance of a small plover, (Kentish plover), fluttering its wings in front of the stone-curlew. Suspecting a nest, I walked up and began searching but was much surprised not to find any eggs or young. Nevertheless, knowing that such behaviour could not have been evoked without there being eggs or young I continued my search. Eventually I found two scrapings, which were obviously made by the plovers but were quite empty. Then I noticed near one of the scrapings some ants gathering on what seemed like a small spot of wet sand. On closer inspection I found that it was some yolk. This evidence immediately caused me to suspect the stone-curlew of some mischief; it had by then walked quite unconcernedly some 60 yards away. This stone curlew was shot immediately, and a post-mortem revealed freshly broken eggs and yolk of the Kentish plover, in its gizzard. However, the most

interesting part of the incident was that the stone-curlew left no trace of the eggs having been eaten, except for a few drops of yolk it had spilt. The eggs had almost been swallowed entire. This incident recalls the agitation of a pair of Kentish plovers at the approach of a Great stone-curlew at Victor, when I first discovered the former species breeding there. (Recorded Vol. 46 No. 4, page 728.) The Great stone-curlew may eat the eggs of this plover, but I very much doubt whether it makes a habit of searching for them since these small plovers are not common breeders in Saurashtra, but it evidently has an appetite for eggs.

DILBAHAR,
BHAVNAGAR, K. S. DHARMAKUMARSINHJI
25th September, 1949.

[K. S. Dharmakumarsinhji has recorded the nesting of this species at Victor, Bhavanagar State on 2nd June (*J.B.N.H.S.* Vol. 46, p. 728). The Fauna rightly states that it breeds numerously in Sind, but the addition "as far south as Guzerat in Cutch" is not supported by Sálim Ali in 'The Birds of Kutch'. Bulkley however found it nesting at Kharaghoda (*J.B.N.H.S.* Vol. VIII, p. 325) and Whitehead (*J.B.N.H.S.* Vol. XXI, p. 161) saw two pairs in breeding plumage at Sehore, Bhopal State, Central India, on 1st May suggesting that they were not far from their nesting haunts.—EDS]

10.—OCCURRENCE OF THE BLACK STORK *CICONIA NIGRA* (LINN) IN TIBET.

Mr. H. E. Richardson writing from Lhasa on 22 September 1949 gives the description of what was obviously a Black Stork (*Ciconia nigra*) seen by him on the bank of a river in Pembo Valley to the north of Lhasa.

Although Tibet is within the general distribution of this bird, no specific instance of its occurrence in this area seems to be on record.

Black storks breed in Germany, Austria and Eastern Europe to North Central Asia. They visit Africa, India and China in winter.

114, APOLLO STREET,
FORT, BOMBAY, EDITORS
15th October, 1949.

11.—'PECULIAR BEHAVIOUR OF THE DARTER (*ANHINGA MELANOGASTER* PENNANT)'

I read Mr. Humayun Abdulali's Miscellaneous Note (Vol. 47, p. 549) about the peculiar behaviour of the Darter with considerable interest. Towards the end of the Great War, I was stationed in Bharatpur and in 1918, a year in which the heronry in the

Keoladeo Ghana reached vast proportions, thanks to a favourable monsoon, I noticed this same habit. I would like to point out that it is not only adult Darters which are wont to drop plumb into the water with closed wings. It must be an instinctive habit for even small nestlings when frightened will hurl themselves over the side of the nest, unfeathered downy young which can have no chance of getting back to the nest.

In Vol. 30, No. 2 p. 309, in an article describing this heronry, I wrote of the Darters, '. . . when the young birds had been hatched long enough to take an active interest in what was going on around and below them, to approach anywhere near needed considerable courage. The moment one got well beneath a tree full of them, a general panic appeared to set in. Before, I had only heard the expression 'sick with fright', but these birds introduced me to the reality. One was greeted with a shower of disgorged sprats ranging from an inch to three inches in length, which pattered into the water and into the punt like hailstones. Occasionally, a large plop informed one that a youngster, anxious, to efface itself completely, had dived overboard. I hardly ever saw these adventurous spirits come to the surface again, although, even at this age, when they were still but black downy morsels, they were expert swimmers and divers. I was able to follow them under water occasionally, until they dived into the submerged branches of some bush, where I suppose they came up to look round, or, what is more likely, where they became entangled and were drowned. I fear they must all have met with a watery death, as they were still unable to stand upright, and I saw numbers floating dead on the surface. In fact after a time I avoided their vicinity altogether, as it was really cruel to disturb them.

It may also interest readers to know that many huge Monitor Lizards were frequently to be noted in the heronry at this time lying in the water or on the half-submerged branches. The young Darters must have provided them with many a meal, but there were, of course plenty of casualities amongst both young and adults of all the species nesting in the Ghana to supply them with the food they required.

BEN RHYDDING,
ILKLEY,
October, 1948.

R. S. P. BATES
Lt.-Col.

12.—'THE BIRDS OF DELHI AND DISTRICT'

In 'Stray Sport' by J. Moray Brown (1893) a chapter is devoted to small game shooting within a few miles of Delhi, from which attention might be drawn to statements which add to or differ from the recent lists of Delhi birds published in the *Journal* ('The Birds of Delhi and District' N. F. Frome, *J.B.N.H.S.* Vol. 47, pp. 277-300 and additional notes by E. C. Benthall and H. G. Alexander, J.B.H.N.S. Vol. 48, pp. 368-372).

Megalaima zeylanicus—The Green Barbet. This is mentioned among other common birds seen by Brown and presumably belies

Frome's theory that this species is a new arrival in Delhi 'as it is not in Basil-Edwardes list and has not been noted in Delhi before 1939'. *Psittacula eupatria* and *Psittacula krameri* are mentioned as common, and 'a parakeet curry is not to be despised. It is also a great favourite with the British soldier. When I came home from India with my regiment we had 900 parakeets on board.'

Chalcophaps indica—Emerald Dove. The author refers to this species as 'a not unworthy dish when hard up for food', though considering the quantity of buck, chinkara, peafowl and other game shot over a three-day trip, this eventuality is hardly likely to have arisen. This species may have got included in the Delhi list in error.

Botaurus stellaris—The Bittern. Four were bagged in the course of a snipe shoot at Mongolpoor where 3 guns got over a hundred couple of snipe on 26th November.

Published in 1893, Brown refers to these notes having been made some years before, but it is interesting to remember that there was a time when a single gun could make a mixed bag of 60 odd head including antelope, hare, common and painted sand-grouse, black partridge, quail, snipe, mallard, teal, pochard and whistling teal, all on and within 3 miles of the Ridge!

114, Apollo Street,
Fort, Bombay EDITORS
1st November, 1949.

13.—A COBRA'S STRANGE MEAL

A correspondent, Mr. Ramesh Bedi, sends us the stomach contents of a cobra he recently captured at Haradwar. Under excitement of capture, it seems to have thrown up the remnant of a recent meal which consisted of the following items:—

(1) the remains of a juvenile mouse, partially digested,
(2) a piece of khadar cloth 17″ × 14″, and
(3) a small lump of cotton.

It is probable that the cloth was used by the rodent to line its nest with, and the snake relying mostly on its sense of smell swallowed its prey together with the nest all in one meal.

The sense of taste in snakes is poor as shown by the fact that they will sometimes swallow pieces of cloth, stick etc. which have come in contact with and absorbed the scent of rats. A. F. Abercromby (*J.B.N.H.S.* Vol. 28, p. 812) records an instance of a python in the London Zoological Gardens which swallowed a rug kept in its cage to keep it warm, while in the Society's rooms there once lived a 12-foot Malay python along with another slightly longer than itself which when a dead partridge was introduced into the cage swallowed not only the bird but its companion as well, plus a red blanket to round off the meal!

114, Apollo Street,
Fort, Bombay, EDITORS
20th October, 1949

14.—A NOTE ON THE OCCURRENCE OF A GIANT BALANOGLOSSID AT KRUSADAI ISLAND

During an instructional tour of the B.Sc. senior students under our guidance, on the morning of 24-8-1949, at the Galaxea Reef at low tide a remarkable Balanoglossid was collected by the party.

It was pulled out from its burrow about 20 feet from the shore-line. The area was completely exposed during low tide. Its total length measured 26½ inches (Twenty six and half inches) from the tip of the proboscis to the anus. The diameter measured half an inch throughout. The specimen was kept alive for a day in a basin of fresh sea-water.

A specimen of this length was never recorded from Krusadai before. Another point of interest is its solitary occurrence on the Galaxea Reef area, though there is a separate Balanoglossus area near the Bushy point of the Island.

It is proposed to work out the systematics, and anatomical peculiarities of this giant specimen.

Department of Zoology,
Presidency College,
Chepauk, Madras-5,
2nd September, 1949.

P. JOHN SUNDARA RAO
S. RANGA RAO

15.—'A HONEY-BEE IN THE NEST OF A MASON-WASP'

In the *Journal* of August '48, a note of mine describing the finding of a honey bee in the nest of a mason-wasp seemed to have given rise to some uncertainty as to the true identity of the captive, and the question whether any of the mason-wasps did in fact select honey bees to store in their clay nests.

I was therefore interested to come across the following passage in 'The Tribes on My Frontier' by EHA, (p. 80.) recently: 'In making calculations, however, it must be remembered that all these waspy tribes do not combine to exterminate grass-spiders. A large fellow of the hornet pattern always appears dragging along fat green caterpillars, another prefers the smaller caterpillar of a particular kind of moth, another collects house-spiders, another aphides, another flies, one is said to stock its nest with honey-bees. . . . '

In another book that I found in the Nilgiri Library at Ootacamund—'The Mason-wasps' by J. H. Fabre—there is a foot-note referring to his 2nd volume under the same title and in which he discusses the capturing and storing of honey bees, by another species of mason-wasp; but, unfortunately, I have not been able to find the volume referred to, in that Library. However, in the light of these two references, I feel that what I found in a mason-wasp's nest actually was a honey bee.

'Walmer',
Lovedale, (Nilgiris),
8th July, 1949.

K. BOSWELL

16.—NOTE ON THE LARVA OF *AMBLYPODIA CENTAURUS*

Mr. D. G. Sevastopulo remarks (Some Suggestions for Entomological Work in India, Vol. 48, No. 1, p. 81) that as yet no Indian Lycaenid larva is known to be unable to survive by reason of the honey gland becoming choked with mould if the attendant ants are removed.

In 1948 I observed this phenomenon in connection with a small series of larvae of *Amblypodia centaurus,* though I should like to confirm my findings with a much larger series.

On 21st July I found 7 larvae of *centaurus* feeding on a low secondary growth of *Lagerstroemia flos-reginae,* all attended by the common red tree ant (*Oecophylla smaragdina*); of these larvae 6 were nearly fully grown, and one but newly changed into its last larval skin. One larva was lost, and the remaining 6 were kept in a metal glass-topped breeding tin, without ants. I give their respective fates in the order that they spun up for pupation:—

No. 1. Pupated normally, but the resulting imago was deformed.

No. 2. Spun up and pupated, but within 24 hours of pupation a patch of mould appeared on the dorsum just anterior to the cremasteric pad. Subsequently the pupa liquified.

Nos. 3-5 Spun up, but before pupation could take place a patch of mould appeared on the dorsum at the position of the honey gland, resulting in death.

No. 6. The youngest larva of the series. Died before it was fully fed.

At the end of July I found 3 more nearly fed larvae, which I foolishly left on the bush till they should grow larger. When 2 had disappeared I collected the remaining one and put it, together with 2 or 3 of the attendant ants, in the breeding tin used for the former batch. The ants were replaced by fresh individuals when necessary, and the larva completed its life history without a hitch. This larva, like the previous 6, was in captivity for approximately a week before spinning up for pupation.

The larva of *centaurus* has a curious characteristic, which I have not seen in any other species. Whether walking or at rest it is in a state of constant vibration. This cannot be seen by the naked eye but is most noticeable to the hand, even when held on a piece of paper.

The honey-dew glands on the 10th segment are unusually large and resemble a pair of miniature electric bell pushes, being withdrawn or protruded at will.

Seleng T. E.,
Seleng Hat P.O.,
Upper Assam, T. NORMAN

11th September, 1949.

17.—OBSERVATIONS ON *APHIS ASCLEPIADIS* PASSERNI (APHIDIDAE: HEMIPTERA).

The common yellow aphid, *Aphis asclepiadis* Passerni, occurring on *Calotropis* and other plants of the Natural Order Asclepiadaceae, has been reported in India from Lahore (Das, 1918), Delhi, Rohtak and Karnal (Ullah, 1940), Poona (Deshpande, 1937), Coimbatore and Bellary (George, 1927) and Mysore (Krishnamurthy, 1928) under the name of *Aphis nerii* Fonscolombe. Goot (1917), gave a list of specimens of aphids in the collection of the Indian Museum and referred to this species as occurring in Calcutta and on Barakuda Island of the Chilka Lake, Orissa. Recently, Mukerji and Behura (1948) proposed the name *A. asclepiadis* for this species. There is no previous record of this species in the mainland of Orissa, but *A. asclepiadis* has been observed by me on *Calotropis gigantea* Br., and *C. procera* Br., in various parts of the district of Cuttack e.g. Chandgapatna, Harinabe, Rohia, Bilipada and Rokida in the Balikuda sub-division. In the city of Cuttack, between 10-10-1945 and 7-11-1945, host plants were heavily infested with *A. asclepiadis*.

Two species of ants viz:—*Acantholepis frauenfeldi* Mayr,. and *Cremastogaster dorhni* Mayr., attend on *A. asclepiadis* in India (Mukerji and Behura, 1947). Ayyar (1935) intimated that *Camponotus* (*Tanaemyrmex*) *compressus* Latr., though associated with other species of aphids, does not usually attend on aphids and membracids on poisonous plants like *Calotropis*. However *A. asclepiadis* infesting *Calotropis* plants, in the various parts of Orissa mentioned above, were without exception being attended by minor workers of *C. compressus*. The ants were also found in fair numbers on the lower leaves of the plants feeding upon the honey dew rejected by the aphids.

My observations thus imply that *A. asclepiadis* occurs in Orissa and that the species although found on poisonous host plants is attended by *C. compressus*.

Department of Zoology,
University of Edinburgh,
Edinburgh, Scotland, B. K. BEHURA

23rd October, 1949.

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